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REVIEW OF CANADIAN TRICHOPTERA

I. THE FAMILY RHYACOPHILIDAE (ANNULIPALPIA)

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REVIEW OF CANADIAN TRICHOPTERA
I. The Family Rhyacophilidae (Annulipalpia)

F. SCHMID

Introduction

In 1980, I published a study entitled "Genera of the Trichoptera of Canada and the Adjacent States" containing descriptions and identification tables for all the taxonomic groups in this order above the level of the species (sub-orders, families, sub-families, genera, and sub-genera); and information on the morphology and biology of these insects. This study was the first in a series that will describe our Trichoptera fauna at a more specific level.

The second volume in the series, which appears now in a different edition, deals with the family Rhyacophilidae. The Ryacophila is a large family of Trichoptera that is widely distributed throughout the Northern Hemisphere. Until 1956, it included five sub-families: Rhyacophilinae, Hydrobiosinae, Glossosomatinae, Agapetinae, and Protoptilinae. Today, Ross classifies the last three into a separate family: the Glossosomatidae. In 1970, I decided to classify the Hydrobiosinae as a family. This group, which is mostly distributed throughout the southern hemisphere, resembles the Rhyacophila only in terms of its primitive larval characteristics, while the adults have practically nothing in common.

Biology

Rhyacophila inhabit running waters of all kinds, even small temporary streams. They live mainly in mountainous regions where they populate all altitudes, but their areas of distribution are sometimes quite restricted. Several species may live together in the same streams. They do not usually populate arctic regions.

The ecological characteristics of this species described in the following sections are based on my own observations, and those made by Nimmo 1971, Flint 1962, and Anderson 1976. The larvae live freely under rocks and construct a portable case for pupation before metamorphosizing. They are mostly predaceous, although a small number will eat living or dead plant matter.

Morphology

In order to identify the males, it is necessary to lift the lower left appendage to examine the internal organs that are normally hidden by these appendages. This has been done for all the figures in this study. In both sexes, it may be necessary to treat the abdomen with KOH, in order to evaginate the last segments and free the vaginal apparatus.

This study does not contain general diagrams of the genital structures. The male genital organs show such variations and permutations that a general diagram would be practically useless; instead, I have used abbreviated legends to accompany the figures illustrating the characteristics used in the identification tables, as necessary. The abbreviations used are:

éd. - aedeagus
l.d.Xe - apicodorsal lobe of the IXth segment
l.v.éd. - ventral lobe of the aedeagus
par. - paramers
p.d.Xe - dorsal section of the Xth segment
phall. - phallotheca
pl.v.éd. -ventral plate of the aedeagus
pr. - preanal appendage
p.v.Xe - ventral section of the Xth segment
s.a. - anal sclerite(s)
U - apical band
IIe - second segment of lower appendages
IXe - IXth segment
Xe - Xth segment

A complete study of the morphology of the genital organs of both sexes can be found in Schmid 1970, p. 13-16.

Acknowledgements

I am deeply indebted to Mr. G.B. Wiggins, of the Royal Ontario Museum, Toronto; Mr. O.S. Flint, of the U.S. National Museum, Washington; the late Mr. H.H. Ross, of the University of Georgia, Athens; and Mr. D.G. Denning, of Moraga, California, for their significant contributions of material. Mr. D.G. Denning also provided me with a list of Canadian locations where Rhyacophila have been captured.

Family Diagnosis

Rhyacophilidae, Stephens 1836: 148. Type genus: Rhyacophila Pictet.
Rhyacophilidae Schmid 1980, p. 25.

Head short and very broad. Eyes very large, with short and sparse pilosity. Large ocelli. Antennae smooth, a little shorter than the front wings with the scape not well differentiated. Large maxillary palpi, with the first two segments short, and the second subglobular; the last three segments are long, with the 5th ending in a short conical point.

The two pairs of wings are regularly elliptical, of similar shape and width, and show no sexual dimorphism. Complete venation with all branches (I, II, III, IV, and V) present in the fore-wings; and branches I, II, III, and V in the hind-wings; all are sessile with the exception of fIII in the two wings. The end of RI is divided into RIa and RIb and a cross-vein r is present in the two wings. Discoidal and medial cells open in both wings. The thyridial cell of the front wings is very long.

The legs are long and slender, with few spines and not enlarged in the female. In both sexes, spurs 3, 4, 4 are large and subequal in length. In both

sexes, the inside face of the femora in the three pairs of legs is covered with a row of long slender bristles. In the male, the apical half of the posterior margin of the back femora contains a row of very short and regular fine bristles. This comb probably serves to spread the secretions of the Vth sternite over the lateral faces of the abdomen. This sternite is not very protuberant and its internal gland is not well developed. The abdominal hemobranchial apparatus is absent.

Rhyacophilidae include only two genera. The small genus Himalopsyche is distributed throughout the East, except for the single species phryganea Ross, which has emigrated west into the Rocky Mountains of the United States, but has not been found in Canada. On the other hand, the large and beautiful genus Rhyacophila is holarctic and widely represented in Canada. It can be distinguished from Himalopsyche only by its smooth mesoscutellum. This single genus (Rhyacophila) will be the object of this study.

Generic Diagnosis

Rhyacophila Pictet, 1834: 181. Type species named by Ross 1944: Rhyacophila vulgaris Pictet.
Rhyacophila, Schmid 1980: 25.
Revisions: Ross, 1956, Schmid 1970.

Medium to small species measuring between 12 and 43 mm. The female is a little larger than the male. The front wings are dark and originally covered with light spots. The back wings are lighter and uniformly coloured.

Male Genitalia: The IXth segment is annulate and occasionally forms an apicodorsal lobe which dominates the other genital organs. The shape of the Xth segment is quite varied and sometimes very complex. Anal appendages present or absent. The appendages that are called intermediate in the other families are called anal sclerites in this case. They are almost always small and heavily sclerotized; they may be present or absent, paired or unpaired. There is also a U-shaped apical band with slanting arms between which emerges the anus. Lower appendages in the shape of an oval pincer; they are very large, subhorizontal, and consist of two segments. The second segment is shorter, almost always notched in a characteristic pattern, and armed with spinules in the inside. The phallus, which has a complete primitive structure, is located between the lower appendages, with a sclerotic connection to the base of the latter. It consists of a phallotheca and an endotheca, both short; the aedeagus, and generally two more or less spiniform paramers, all very long. Sometimes, there is a dorsal appendage above the aedeagus and a ventral lobe located under it.

Female Genitalia: VIIIth segment is annulate or in the shape of a truncated cone, often showing apical notches isolating lobes that have a very characteristic shape in each species. Virtual IXth segment is undistinguishable from the VIII-X intersegmental membrane. The last segments and their connecting membranes are often quite long and form a flexible and retractable ovipositor containing two pairs of apodemal stalks where the muscles used for the retraction of the ovipositor are inserted. The VIII-X intersegmental membrane is frequently invaginated into the VIIIth segment over a variable length. XIth segment in two paired oval lobes at the apex of which is inserted the cercus, which is always a single process. The vulvar scale is absent and the anovaginal opening emerges at the apex of the Xth segment. The vaginal apparatus is located at the end of a very long vaginal vestibule with membranous walls so fine that they are almost invisible; thus, the vaginal apparatus seems to float freely inside the abdomen. When mating, the vaginal vestibule retracts upon itself like the finger of a glove, and the vaginal apparatus comes out of the abdomen. Its structure provides excellent species-related characteristics.

General Considerations

Rhyacophila is the most primitive genus of the whole order; this is evident in the structure of the head and its appendages, the complete 3, 4, 4 calcar arrangement; the shape and venation of the wings, and the male genital characteristics. On the other hand, it is difficult to say whether or not the presence of a long retractable ovipositor in the female is a fundamentally primitive characteristic. Nevertheless, Rhyacophila is a very abundant group widely distributed in the eastern and holarctic regions. It includes some 500 known species, of which less than 100 live in North America.

Rhyacophila is one of the most remarkable genera in this order. The male genitalia are highly developed, and unquestionably beautiful and graceful in shape. They show a paradoxical combination of two contrary characteristics: a considerable range of variation in the detail, within total stability of their larger architectural lines. The exploration and contemplation of this beautiful example of unity, multiplicity, and diversity within a homogeneous pattern, are a source of true esthetic pleasure for those who can appreciate these things.

Classification

The first attempts to classify the genus Rhyacophila were carried out by Ross (1956, Map 16), who divided it into nine branches containing a large number of species. However, this system was not entirely satisfactory so that, in turn, I revised this classification (1970, Fig. 8), and concluded that the genus can be naturally divided into four branches, two of which can be further sub-divided to form some 70 groups of species. Moreover, a small number of isolated forms have remained unamenable to the constraints of classification.

For the purposes of this study, we will take into consideration only branches and groups. It is clear that these four branches represent the natural sub-genera. However, it would be better not to name them. First, in order to avoid destroying the beautiful homogeneity of such a remarkable genus; and then, because their boundaries are so flexible that it is not possible to produce clear and precise generic descriptions, to say nothing of dichotomic tables. The branches are based on the characteristics of their respective ancestors. However, these fundamental characteristics are sometimes entirely modified, or even completely disappear, in certain species.

Thus, in the following tables, the genus is treated as a block, and the species grouped in the most convenient order for identification. This order is entirely different for males and females, and only partially corresponds to their natural classification. In the illustrations, the figures have been grouped in the same order as that used for the species on the tables. However, the following descriptions follow a natural taxonomic order. As mentioned above, it is not possible to produce clear taxonomic descriptions of the groups, that can be used for all the species in each of these lines. In this study, I will describe only a small number of characteristics, primitive or not, that apply to the species found in this country.

TABLE OF MALES
(complex genitalia, lower appendages with two segments forming an oval-shaped pincer)

1a Western species (Map 2) 2
1b Eastern or central species (Map 2) 39

2a Upper section of genital armature forming a trilobate, compact, rounded structure consisting of the medial lobe of the IXth segment attached to the preanal appendages (Figs. 1, 2, 16-17) 3

2b Upper section of genital armature is not divided into three parts (Figs. 21-30)..... 7

3a Very large preanal appendages, that are as long as high (Figs. 16, 17) ..... oreta p 16

3b Smaller preanal appendages, that are longer than high (Figs. 1-2) 4

4a Ends of the apical band (U) are truncated, straight, or rounded (Figs. 3, 15, 20) 5

4b Ends of the apical band more or less tapered (Figs. 6, 9, 12) 6

5a Ends of the apical band truncated and without projecting margins. Anal sclerite branching out in the form of a V (Fig. 3) ..... norcuta p. 15

5b Ends of the apical band mostly rounded and with the internal apical margin raised in the form of a keel. Anal sclerite in the form of a rectangle, with a deeply incised back (Fig. 20) ..... donaldi p. 13

5c Ends of the apical band are straight and without protuberant margins. Anal sclerite is semi-elliptical and not bifurcate (Fig. 15) ..... latitergum p. 15

6a Ends of the apical band are tapered. Smaller anal sclerite accompanied by two subspherical internal concavities (Fig. 6) ..... tralala p. 16

6b Ends of the apical band rather narrow. Trapezoidal anal sclerite (Fig. 9) ..... rotunda p. 16

6c Ends of the apical band mostly rounded, with acute internal angles. The lateral margins of the anal sclerite are parallel (Fig. 12) ..... ebria p. 13

7a Aedeagus contains an unpaired ventral lobe, and is quite large, well differentiated, membranous, and highly erectile. The tip is more or less sclerotized, and contains strong bristles or spines that cover a considerable area (Figs. 23, 33) 8

7b Aedeagus has lobes that are quite similar but paired (Fig. 39) 13

7c Aedeagus has other appendages which vary in structure or number (Figs 44, 48) 21

8a IXth segment forms an apicodorsal lobe which overhangs the Xth segment (Figs. 31, 32) 9

8b IXth segment without an apicodorsal lobe (Fig. 33) 10

9a Xth segment forms two small, paired lateral lobes, which look triangular in profile (Fig. 31) ..... rickeri p. 51

9b Xth segment forms an unpaired horizontal plate, which looks 3 times longer than high when viewed in profile (Fig. 32) ..... autumnalis p. 51

10a Aedeagus is very long, smooth and slender (Figs. 33, 35) 11

10b Aedeagus is short and complex (Fig. 37) 12

11a Dorsal sector of the Xth segment is deeply notched to form a V with clearly divergent branches (Fig. 36) ..... pellisa p. 41

11b Dorsal sector of the Xth segment slightly notched into two short rounded lobes (Fig. 34) ..... valuma p. 42

12a Dorsal section of the Xth segment forms a very large horizontal plate, clearly longer than the lower appendages (Fig. 37) ..... narvae p. 39

12b Dorsal section of the Xth segment is slanted and of medium size (Fig. 38) ..... blarina p. 37

13a Ventral lobes of the aedeagus do not form a head, and are covered with spines in an apical position (Fig. 23) 14

13b Ventral lobes of the aedeagus form a head and are covered with spines in a subapical position (Figs. 39, 41) 19

14a The preanal appendages cover most of the front apical section of the IXth segment (Fig. 21) 15

14b Preanal appendages do not cover the IXth segment (Fig. 30) 16

15a Preanal appendages form a heart-shaped figure which looks wider than long when viewed from above (Fig. 26) ..... gemona p. 54

15b Preanal appendages are as long as wide and clearly larger than the anal sclerites (Fig. 24) ..... vemna p. 55

15c Preanal appendages are not heart-shaped, not rounded, and barely larger than the anal sclerites (Fig. 22) ..... robusta p. 55

16a Lower margin of the first segment of the lower appendages is deeply concave forming a straight basal angle (Fig. 29) 17

16a Lower margin of the first segment of the lower appendages is not very concave and forms a very obtuse angle or no angle at all (Fig. 27) 18

17a IXth segment forms a very fine apicodorsal point which dominates the anal sclerites (Fig. 29) ..... acropedes p. 57

17b IXth segment does not form a point (Fig. 30) ..... vao p. 60

18a Anal sclerites almost as long as the lower appendages with clearly raised tips (Fig. 28) ..... grandis p. 57

18b Anal sclerites are shorter and look subrectangular in profile (Fig. 27) ..... inculta p. 58

19a Dorsal section of the Xth segment is a little longer than the ventral section and has a long split at the end (Figs. 39, 40) ..... angelita p. 33

19b Dorsal section of the Xth segment a little longer than the ventral section with a short split (Figs. 41, 42) 20

20a Head of the ventral lobe of the aedeagus is very long and pointed (Fig. 41) ..... vuzana p. 35

20b Head of the ventral lobe of the aedeagus shorter and oval-shaped (Fig. 43) ..... perplana p. 35

21a Xth segment consists of two vertical parallel single plates which look triangular in profile. Ventral plate of the aedeagus is membranous, trilobate and unpaired (Fig. 44) 22

21b Xth segment consists of two well-defined complex plates. Ventral plate of the aedeagus forms two large obtuse lobes which are membranous and paired (Fig. 48) 23

21c Different characteristics 24

22a Upper margin of the second segment of the lower appendages deeply and regularly concave. Apicodorsal section of the IXth segment covers most of the Xth segment (Fig. 44) ..... vocala p. 26

22b Upper margin of the second segment of the lower appendages slightly concave. Dorsoapical section of the IXth segment covers the Xth segment over a shorter length (Fig. 45) ..... hyalinata p. 25

23a Second segment of the lower appendages notched at the end. Xth segment without a upper basal lobe (Fig. 46) ..... bifila p. 28

23b Second segment of the lower appendages is subtriangular, small and unnotched. Xth segment without an upper basal lobe (Fig. 48) ..... insularis p. 30

23c Second segment of the lower appendages is large and unnotched. Xth segment has an upper basal lobe which is not well differentiated (Fig. 238) jenniferae p. 30

23d Second segment of the lower appendages is large and unnotched. Xth segment with a well defined upper basal lobe (Fig. 239) ..... coloradensis idahoensis p. 28

24a Light orange species. IXth segment with an apicodorsal section forming a large bifid lobe sharply curved toward the bottom (Fig. 49) ..... verrula p. 52

24b Different characteristics 25

25a Unpaired anal sclerites in the shape of a large vertical plate almost as high as the Xth segment (Fig. 50) ..... vaefes p. 62

25b Different characteristics 26

26a Phallotheca in the shape of a truncated cone of considerable size extending far into the interior of the abdomen beyond the IXth segment (Figs. 51 to 54) ... 27

26b Different characteristics 28

27a Second segment of the lower appendages is subtriangular and ends in two small spiniferous lobes of complex shape (Fig. 51) ..... vaccua p. 50

27b Second segment of the lower appendages is subtriangular with an apical upper margin which is slightly concave and undulated (Fig. 54) ..... fenderi p. 47

27c Second segment of the lower appendages is subquadrangular, with the apical margin slanting front and bottom (Fig. 53) ..... malkini p. 48

27d Second segment of the lower appendages is subquadrangular, with a vertical apical margin (Fig. 52) ..... chilsia p. 47

28a IXth segment strongly notched under the lateral faces for the insertion of the base of the lower appendages. The inner side of the second segment has two areas of spinules (Figs. 55 to 58) 29
28b Different characteristics 31
29a Second segment of the lower appendages with apical notching over more than half the length of the segment (Fig. 55) ..... glaciera p. 23
29b Second segment of the lower appendages with apical notching over approximately half the length of the segment (Fig. 57) ..... kincaidi p. 23
29c Second segment of the lower appendages with barely noticeable notching (Figs. 56, 58) 30
30a Paramers with a well-defined spiniferous lower subapical swelling (Fig. 56) ..... alberta p. 22
30b In this case, the swelling is barely noticeable (Fig. 58) ..... tucula p. 25
31a Apicodorsal section of the IXth segment stretches well to the back and forms a lobe or protuberance (Figs. 59 to 64) 32
31b Apicodorsal section of the IXth segment does not stretch back (Fig. 65) 33
32a IXth segment stretches quite far and the end covers the Xth segment, which is small and in the shape of a small knob (Fig. 64) ..... vedra p. 50
32b Apicodorsal section of the IXth segment forms a bifid deeply concave lobe above the Xth segment, which is massive (Fig. 63) ..... arnaudi p. 60
32c Apicodorsal section of the IXth segment stretches into a very long slender bifid appendage which dominates the Xth segment, itself rather slender and almost as long (Figs. 61, 62) ..... vagrita p. 20
32d Species quite similar to the previous one; however, in this case the apicodorsal lobe of the IXth segment is divided into three parts (Figs. 59, 60) milnei p. 19
33a Xth segment very long (Figs. 65, 67, 69) 34
33b Xth segment short (Fig. 66) 35
34a Dorsal and ventral sections of the Xth segment are both very long. Second segment of the lower appendages is very long and narrow (Fig. 65) unimaculata p. 41
34b Dorsal section of the Xth segment very long and the ventral section is absent. Second segment of the lower appendages deeply notched (Fig. 69) ... vetina p. 42
34c Dorsal branch of the Xth segment also very long, and ventral branch reduced to a hook. Second segment of lower appendages is not notched (Fig. 67)..belona p. 37
35a Xth segment forms two paired medial lobes and an unpaired lower lobe (Fig. 66) ..... visor p. 63
35b Xth segment has a different shape 36
36a Second segment of the lower appendages has a complex profile with apical notching separating an upper lobe in the shape of a spine (Fig. 71). perda p. 48
36b Second segment of the lower appendages has a simple shape (Fig. 72) 37
37a Each of the abdominal tergites (III through VI) has a tubercule with very long cilia (Fig. 73) ..... alexanderi p. 62
37b Abdominal tergites without such tubercules 38
38a Second segment of the lower appendages is massive and smoothly rounded (Fig. 75) ..... ophrys p. 44
38b Second segment of the lower appendages is subquadrangular with a vertical apical margin, and a slightly stretched lower apical angle (Fig. 74) ..... vobara p. 45
38c Second segment of the lower appendages is deeply notched with the upper apical angle stretched into a triangular tip (Fig. 77) ..... vofixa p. 45
38d Second segment of the lower appendages with a slightly concave apical margin (Fig. 76) ..... iranda p. 44

39a Aedeagus has an unpaired ventral lobe that is quite large, well-differentiated, membranous and very erectile. The tip is more or less sclerotized and has one or two areas of bristles (Figs. 78 to 82) 40
39b Aedeagus has two similar paired ventral lobes (Fig. 83) 42
39c Aedeagus without a membranous ventral lobe or showing different characteristics 44
40a Lower appendages 4 times longer than the Xth segment (Fig. 82) .... atrata p. 35
40b Lower appendages not much longer than the Xth segment (Fig. 78) 41
41a The head of the ventral lobe of the aedeagus is concave on the top and has two almost symmetrical areas of spinules (Fig. 79) ..... manistee p. 38
41b Ventral lobe of the aedeagus similar to the previous one but having two highly asymmetrical areas of bristles (Fig. 81) ..... minora p. 39
42a IXth segment forms a fine apicodorsal tip. Aedeagus in the shape of a long and slender cylinder (genitalia similar to acropedes, Fig. 29) ..... ignorata p. 58
42b IXth segment without an apicodorsal tip. Aedeagus short and complex 43
43a Xth segment consists of two superimposed sections forming a V open to the back. Ventral lobes of the aedeagus end in a long bristly oval (Fig. 39) ..... angelita p. 33
43b Xth segment does not form a V but has two parallel branches. Each ventral lobe of the aedeagus ending in two long bristly tips (Fig. 83) ..... glaberrima p. 20
44a IXth segment is significantly narrowed in the ventral section (Figs. 84, 86)..45
44b IXth segment not narrowed in the ventral section (Fig. 85) 46
45a When viewed from the side, the Xth segment appears as a vertical narrow band. Upper margin of the second segment of the lower appendages is slightly convex (Fig. 84) ..... fuscula p. 17
45b Xth segment has an apicodorsal section which forms a roof above the anal sclerites. Upper margin of the second segment of the lower appendages is slightly concave (Fig. 86) ..... vuphipes p. 19
46a Apicodorsal section of the IXth segment only slightly covering the base of the Xth segment. Very large, short, and highly membranous phallic apparatus (Figs. 90 to 99) 48
46b Apicodorsal section of the IXth segment does not cover the Xth segment. Phallic apparatus shows different characteristics 47
47a Second segment of the lower appendages long, rectangular, notched, and longer than the first, which is shortened and has a complex relief in the inner face (Fig. 85) ..... torva p. 54
47b Second segment of the lower appendages is large, mostly rounded, unnotched, and as long as the first, to which it is partly fused (Fig. 87) ..... melita p. 38
47c Second segment of the lower appendages is shorter than the first, as long as it is high, and has triangular apical notching (Fig. 88) ..... carolina p. 22
48a Anal sclerite looks almost as large as the Xth segment, and almost as high as long when viewed from the side (Figs. 90, 92) 49
48b Anal sclerite smaller than the Xth segment and clearly longer than high (Figs. 94 to 98) 50
49a In the dorsal view, the apicodorsal lobe of the IXth segment is slightly trilobate and denticulate (Fig. 91) ..... invaria p. 31
49b Apicodorsal lobe of the IXth segment looks narrow, bifid, and non-denticulate (Fig. 93) ..... vibox p. 33
50a Second segment of the lower appendages is strongly notched. Apicodorsal lobe of the IXth segment well-defined (Figs. 94, 95) ..... banksi p. 31
50b Second segment of the lower appendages is not strongly notched. Apicodorsal lobe of the IXth segment less protuberant 51
51a Xth segment looks quadrangular in profile (Fig. 96) ..... nigrita p. 32
51b Xth segment looks triangular in profile (Fig. 98) ..... carpenteri p. 31

TABLE OF FEMALES
(simple genitalia forming a long ovipositor that can more or less telescope upon itself)

1a Apical margin of the VIIIth segment without lateral incision, or with very slight dorsal or ventral incisions, and straight (Figs. 113, 116) or indistinct (Figs. 100, 105, 106) apical margins 2

1b Apical margin of the VIIIth segment slightly (Figs. 130, 139) or strongly (Figs. 172, 185, 196) incised, laterally (Figs. 139, 164), dorsally (Figs. 119, 120), or ventrally (Figs. 211, 212); or even all at the same time (Figs. 169, 175, 184 to 187) 7

2a Eastern species (Map 2) 3

2b Western species (Map 2) 4

3a VIIIth segment longer than high, strongly attenuated apically, without a clear distal boundary, and a long dorsal groove (Figs. 100, 101). Vaginal apparatus (Fig. 102) ..... angelita p. 33

3b IXth segment barely longer than high, covered with long hairs and with indistinct apical margins on the sides only (Fig. 114) ..... glaberrima p. 20

3c VIIIth segment with a clear transversal basal keel and an indistinct apical margin (Fig. 105). Vaginal apparatus (Fig. 111) ..... minora p. 39

3d VIIIth segment like that on Figure 105. Vaginal apparatus (Fig. 110) ..... manistee p. 38

4a VIIIth segment longer than high, strongly attenuated apically, without a clear distal boundary and a long dorsal groove (Fig. 100) 5

4b VIIIth segment differently organized 6

5a Vaginal apparatus long and narrow (Fig. 102) ..... angelita p. 33

5b Vaginal apparatus wider at the apex than at the base (Fig. 103).. perplana p. 35

5c Vaginal apparatus narrower at the apex than at the base (Fig. 104)..vuzana p. 35

6a VIIIth segment smooth and without anterior and posterior boundaries (Fig. 106). Vaginal apparatus (Fig. 108). Species is orange with dark spots...verrula p. 52

6b VIIIth segment substantially truncated (Fig. 113). Vaginal apparatus (Fig. 107). Uniformly black species ..... blarina p. 37

6c VIIIth segment bluntly truncated (Fig. 116). Vaginal apparatus (Fig. 109). Brown species ..... arnaudi p. 60

7a VIII-X intersegmental membrane is never even slightly invaginated into the VIIIth segment (Fig. 112, 115) 8

7b VIII-X intersegmental membrane always very slightly to partially (Figs. 154, 165, 172); or significantly to completely (Figs. 200, 211, 218) invaginated into the VIIIth segment 15

8a The end of the VIIIth segment is truncated in a straight line (Figs. 112, 115) with dorsal notching (Figs. 119, 120) 9

8b VIIIth segment differently organized 10

9a VIIIth segment strongly attenuated dorso-ventrally, with large dorsal square notches (Fig. 112, 119). Vaginal apparatus (Fig. 117) ..... ebria p. 13

9b VIIIth segment strongly attenuated dorso-ventrally with the apicodorsal margin open and preceded by a large semi-circular depression (Figs. 235, 236). Vaginal apparatus (Fig. 237) ..... donaldi p. 13

9c VIIIth segment with long and narrow dorsal notching preceded by a long narrow groove (Figs. 115, 120) ..... rotunda p. 16

9d VIIIth segment with short dorsal notching preceded by an oval depression, itself preceded by a trapezoidal keel (Figs. 121, 125). Vaginal apparatus (Fig. 123) ..... norcuta p. 15

9e VIIIth segment with short dorsal notching preceded by a triangular depression with the bottom forming a triangular keel (Figs. 124, 126). Vaginal apparatus (Fig. 122) ..... tralala p. 16

10

10a VIIIth segment with an apicodorsal margin forming two triangular fins separated by a triangular notch (Figs. 128, 129). Vaginal apparatus (Fig. 127). oreta p. 16

10b VIIIth segment very slightly sclerotized, with an indistinct but notched margin (Fig. 244). Vaginal apparatus (Fig. 245) ..... rickeri p. 51

10c VIIIth segment differently organized 11

11a VIIIth segment with an apicodorsal margin slightly retracted over the ventral margin and forming an obtuse emerging angle (Fig. 130). Vaginal apparatus (Fig. 131) ..... vagrita p. 20

11b VIIIth segment with the dorsal margin also retracted but forming a straight emerging angle (Fig. 135). Vaginal apparatus (Fig. 132) ..... narvae p. 39

11c VIIIth segment with the apicodorsal margin slightly retracted over the ventral margin and forming a straight re-entering angle (Fig. 139). Vaginal apparatus (Fig. 133) ..... glaciera p. 23

11d VIIIth segment differently organized 12

12a VIIIth segment sharply truncated with a dorsal incision so large that the dorsal and apical margins merge to form a long slanted and undulating line (Fig. 136). Vaginal apparatus (Fig. 140) ..... torva p. 54

12b VIIIth segment differently organized 13

13a VIIIth segment bulges laterally in the middle with the apicodorsal margin in square notches and the ventral margin forming two large rounded lobes (Figs. 134, 137). Vaginal apparatus (Fig. 138) ..... carolina p. 22

13b The front third of the VIIIth segment narrows laterally (Figs. 141, 142). Vaginal apparatus (Fig. 143) ..... vemna p. 55

13c VIIIth segment not longer than high with indistinct apical margins (Fig. 147). Vaginal apparatus, (Fig. 148) ..... grandis p. 57

13d VIIIth segment differently organized 14

14a Apical margins of the VIIIth segment slightly undulated and the ventral section squeezed laterally to form a slight not very protuberant keel (Figs. 144, 145). Vaginal apparatus (Fig. 146) ..... vao p. 60

14b Apical margin of the VIIIth segment slightly undulated and the ventral section pinched laterally to form an angular keel that does not extend beyond the apical margin of the segment (Figs. 150, 152). Vaginal apparatus (Fig. 159) ..... ignorata p. 58

14c Apical margin of the VIIIth segment is straight and the ventral section is pinched laterally to form a sharp keel that extends beyond the apical margin of the segment to form a triangular tip (Figs. 149, 151). Vaginal apparatus (Fig. 152) ..... inculta p. 58

14d Apical margin of the VIIIth segment is straight and the apicoventral section is very strongly pinched laterally to form a high keel that extends beyond the apical margin of the segment to form an oval lobe (Figs. 156, 157). Vaginal apparatus (Fig. 158) ..... acropedes p. 57

15a VIII-X intersegmental membrane invaginated into the VIIIth segment over less than half its length (Figs. 154, 177) 16

15b VIII-X intersegmental membrane invaginated into this segment over more than half its length (Figs. 200, 218) 24

16a Eastern or central species (Map 2) 17

16b Western species (Map 2) 18

17a Apicoventral margin of the VIIIth segment ends in two square or trapezoidal fins separated by a triangular notch (Figs. 154, 155). Vaginal apparatus (Fig. 160) ..... vuphipes p. 19

17b Apicolateral margin of the VIIIth segment forms an obtuse re-entering angle (Fig. 161). Vaginal apparatus (Fig. 162) ..... melita p. 38

18a VIII-X intersegmental membrane invaginated into the VIIIth segment over a short and regular length. Apicolateral margin of the VIIIth segment with an obtuse re-entering angle (Figs. 163, 164). Vaginal apparatus (Fig. 170) .. vobara p. 45

18b VIII-X intersegmental membrane invaginated into the VIIIth segment only along the ventral margin (Fig. 165) 19

18c VIIIth segment differently organized 20

19a Vaginal apparatus forms a stylet with the head clearly smaller than the base (Fig. 167) ..... pellisa p. 41

19b Vaginal apparatus forms a stylet with the head almost as large as the base (Fig. 166) ..... valuma p. 42

19c Vaginal apparatus forms a stylet with the head forming two parallel subapical splits (Fig. 168) ..... atrata p. 35

20a The entire length of the dorsal face of the VIIIth segment is split and the two edges curve towards the split. Lateral apical margins form two rounded fins (Fig. 171). Vaginal apparatus (Fig. 174) ..... vofixa p. 45

20b VIIIth segment with deep narrow apical notching that extends into a suture down to the base of the segment (Fig. 203). Vaginal apparatus (Fig. 204) ..... malkini p. 48

20c VIIIth segment differently organized 22

21a Apicolateral margin of the VIIIth segment forms two quadrangular lateral lobes and two rounded ventral tips (Figs. 169, 175). Vaginal apparatus (Fig. 176) ..... vetina p. 42

21b VIIIth segment differently organized 22

22a VIIIth segment strongly attenuated in the apical section which forms a large triangular ventral lobe and a bifid dorsal lobe (Figs. 172, 178). Vaginal apparatus (Fig. 173) ..... visor p. 62

22b VIIIth segment differently organized 23

23a VIIIth segment very strongly attenuated at the apex with an apical margin forming a straight re-entering angle (Fig. 177). Vaginal apparatus (Fig. 179) ..... vaefes p. 62

23b VIIIth segment ends in two large rounded dorsal lobes and two barely defined but equally rounded ventral lobes (Figs. 180, 181). Vaginal apparatus (Fig. 182) ..... belona p. 37

23c VIIIth segment with lateral faces forming two large rounded lobes only slightly protuberant (Fig. 183). Vaginal apparatus (Fig. 189) ..... iranda p. 44

24a VIIIth segment so deeply notched that it forms lateral (Figs. 184, 191) or ventral (Figs. 196, 200) appendages 25

24b VIIIth segment differently organized 32

25a VIIIth segment forms two lateral and two ventral appendages, with the latter sometimes partially fused (Figs. 184, 186) 26

25b VIIIth segment forms two large lateral appendages and one unpaired, large, ventral lobe (Figs. 191, 193) 27

25c VIIIth segment forms a single ventral appendage (Fig. 196), or one that is less well-defined (Fig. 200) 28

26a Lateral and ventral appendages of the VIIIth segment are distinct, slender, and significantly longer than wide (Figs. 184, 186) ..... bifila p. 28

26b Lateral and ventral appendages of the VIIIth segment are massive, distinct, and slightly longer than wide (Figs. 185, 187) ..... jenniferae p. 30

26c Dorsal appendages of the VIIIth segment tightly triangular, ventral appendages are fused into a large square plate with circular notching (Figs. 240, 241) ..... insularis p. 30

26d Dorsal appendages of the VIIIth segment are bluntly triangular; ventral appendages are fused into a narrow section with the end branching out to form a V (Figs. 242, 243) ..... coloradensis idahoensis p. 28

27a The lateral appendages of the VIIIth segment are rounded (Figs. 191, 193). Vaginal apparatus (Fig. 190) ..... vocala p. 26
27b Lateral appendages of the VIIIth segment are slightly angular (Figs. 192, 194). Vaginal apparatus (Fig. 188) ..... hyalinata p. 25
28a Ventral appendage of the VIIIth segment well-defined and heart-shaped (Figs. 196, 198). Vaginal apparatus (Fig. 197) ..... chilsia p. 47
28b Ventral appendage of the VIIIth segment attached to the segment itself (Fig. 199) 29
29a VIII-X intersegmental membrane invaginated into the VIIIth segment over a section longer than this segment (Fig. 199). Vaginal apparatus (Fig. 195) ..... vedra p. 50
29b VIII-X intersegmental membrane less deeply invaginated into the VIIIth segment 30
30a Ventral appendage of the VIIIth segment is simple and forms a pointed arch (Figs. 200, 201). Vaginal apparatus (Fig. 202) ..... fenderi p. 47
30b VIIIth segment differently organized 31
31a VIII-X intersegmental membrane invaginated into two-thirds of the VIIIth segment (Figs. 205, 206). Vaginal apparatus (Fig. 207) ..... perda p. 48
31b VIII-X intersegmental membrane invaginated into almost the entire length of the VIIIth segment (Fig. 209). Vaginal apparatus (Fig. 210) ..... vaccua p. 50
32a The top of the lateral faces of the VIIIth segment is hollowed into a deep groove (Fig. 221) ..... fuscula p. 17
32b VIIIth segment very bluntly truncated at the end with a prominent ventral angle (Figs. 208, 211) 33
32c VIIIth segment differently organized 36
33a VIII-X intersegmental membrane invaginated into the VIIIth segment over the entire length of this segment (Figs. 208, 211) 34
33b VIII-X intersegmental membrane only partly invaginated into the VIIIth segment (Fig. 218) 35
34a VIIIth segment forming a large triangular apicoventral angle and a small apicodorsal angle (Figs. 208, 216). Vaginal apparatus (Fig. 215) .. carpenteri p. 31
34b VIIIth segment forming a very small apicoventral angle and a large apicodorsal angle (Figs. 211, 212). Vaginal apparatus (Fig. 213) ..... nigrita p. 32
35a Apical margin of the VIIIth segment slants towards the bottom (Fig. 217). Vaginal apparatus (Fig. 214). Western species ..... kincaidi p. 23
35b Apical margin of the VIIIth segment slants towards the top (Figs. 218, 219). Vaginal apparatus (Fig. 220). Eastern species ..... invaria p. 31
36a Eastern species (Map 2) 37
36b Western species (Map 2) 38
37a Apicoventral margin of the VIIIth segment forms two sharp tips (Fig. 222) ..... banksi p. 31
37b Apicoventral margin of the VIIIth segment largely notched (Figs. 223, 224). Vaginal apparatus (Fig. 225) ..... vibox p. 33
38a Apicoventral section of the VIIIth segment forms a large lobe not preceded by notching (Figs. 226, 227). Vaginal apparatus (Fig. 233) ..... tucula p. 25
38b Apicoventral section of the VIIIth segment forming a long slender lobe preceded by notching (Fig. 229). Vaginal apparatus (Fig. 232) ..... milnei p. 19
38c Apical margin of the VIIIth segment with two slight dorsal and ventral protuberances (Fig. 228). Vaginal apparatus (Fig. 234) ..... alberta p. 22
38d Apical margin of VIIIth segment forming two clear dorsal and ventral lobes (Fig. 230). Vaginal apparatus (Fig. 231) ..... unimaculata p. 41

THE VULGARIS BRANCH

IXth segment sharply shortened ventrally with an apicodorsal lobe. Xth segment is not protuberant and lies in a vertical position. The anal appendages surround the apicodorsal lobe of the IXth segment to form a trilobate structure. Apical band large and well sclerotized. Phallic apparatus without a dorsal appendage and without a ventral lobe or plate.

ROTUNDA GROUP

Rhyacophila donaldi Nimmo
Map 1

Rhyacophila donaldi Nimmo, 1970: 29.

Rather small species (length of front wing is 7.84 mm); front wings are uniformly reddish brown with well-defined venation.

Male Genitalia (Fig. 18-20): Trilobate dorsal structure very blunt and almost twice as wide as long, but with relatively narrow preanal appendages. Second segment of the lower appendages rather small, with a slightly convex apicodorsal margin. Apical band in two very rounded lobes, without stretched angles and the apical margin forming a keel. Anal sclerite forms a rectangle that is deeply notched in the back. (Holotype from Row Bk, Watertown National Park, Alberta.)

Female Genitalia (Figs. 235-237): VIIIth segment strongly attenuated at the apex with an indistinct apicodorsal margin. This is open and preceded by a large semi-circular depression almost as large as the segment itself. Vaginal apparatus forms an obtuse oval with short apical notching. (Allotype from Bertha Bk, Waterton National Park, Alberta.)

This species can be easily recognized by the width and rounded shapes of the dorsal structure and apex of the apical band. It is quite similar to ebria.

Rh. donaldi is known in only three original locations, all in Waterton National Park in southwest Alberta. Its known period of flight is from 10-VIII to 8-IX. It seems to frequent subalpine zones between 1800 and 2200 m, and populates small shallow streams with pebbly or sandy bottoms interspersed with rapids and small waterfalls.

Rhyacophila ebria Denning
Map 1

Rhyacophila ebria Denning, 1947: 37.

Medium-sized species (length of front wing is 11 mm); front wings are dark brown with gold spots.

Male Genitalia (Figs. 10-12): Dorsal structure is trilobate slightly wider than long. Second segment of the lower appendages form an irregular quadrangle. Apical band forms two funnel-shaped sections that are significantly concave on top, with stretched internal angles and forming a slight keel with rounded external margins. Anal sclerite forms a long rectangle with a concave apical margin. (Specimen from Eva Lake Trail, Mt. Revelstoke National Park, British Columbia.)

Female Genitalia (Figs. 112, 117, 119): In profile, the VIIIth segment forms a sharply truncated cone. From above, the apicodorsal margin shows deep triangular notching. The vaginal apparatus is rectangular and ends in 4 small rounded lobes. (Specimens from Eva Lake Trail, Mt. Revelstoke National Park, British Columbia.)

This species is quite close to donaldi, from which it can be mainly distinguished by the shorter width of the dorsal structure and by the fact that the internal apical angles of the apical band are drawn out.

Rh. ebria is only known in the typical habitat located in Montana and one other location in British Columbia: Eva Lake Trail, Mt. Revelstoke National Park 29-VII-1952, 6,000 ft (G.P. Holland).

Rhyacophila latitergum Davis

Rhyacophila latitergum Davis, 1950: 448.

Medium-sized species (length of front wings is 10 mm); front wings are brownish black with several light spots on the pterostigma.

Male Genitalia (Figs. 13-15): Apicodorsal lobe of the IXth segment forms a simple oval which is one and a half times longer than wide. Rather large preanal appendages. Second segment of the lower appendages forms two parallel vertical lobes, the apical lobe forms a rounded oval. Apical band forming two quadrangular lobes where the lateral margins are raised. Anal sclerite in the form of a semi-circular knob. (Male holotype from Tomyhay Lake, Washington.) Female unknown.

This species is not close to any other and can be recognized by the strong internal relief of the second segment of the lower appendages, and the quadrangular lobes of the apical bands.

Rh. latitergum is known only in the typical habitat located in the state of Washington.

Rhyacophila norcuta Ross
Map 1

Rhyacophila norcuta Ross, 1938b: 117.
Rhyacophila novarotunda Ling, 1938: 61.

Medium-sized species (length of front wings is 9-13 mm); front wings are blackish brown, speckled with a few fine silver spots.

Male Genitalia (Figs. 1-3:) Apicodorsal lobe of the IXth segment is oval and twice as long as wide. The anal appendages form very drawn-out triangles. Second segment of the lower appendages with a lower apical angle forming a large oval slanted towards the back. From the top, the apical band looks like two square lobes with thickened margins forming hairy pads. Anal sclerite in V, with oval-shaped and very thick branches. (Specimen from Forbidden Plateau, Vancouver Island, British Columbia.)

Female Genitalia (Figs. 121, 123, 125): From the top, the VIIIth segment looks like a truncated cone and shows a short upper medial incision preceded by an oval depression that is itself preceded by a trapezoidal keel. Vaginal apparatus oval and very simple. (Specimen from Wellington, British Columbia.)

Rh. norcuta is widely distributed in the western areas of the continent: British Columbia, Idaho, Washington, Oregon and California. It is rather common and frequent in a large number of various types of streams, including temporary ones. Its known period of flight extends from March to October.

British Columbia: Cultus Lake 13-27-III-1934 (W.E. Ricker). Forbidden Plateau VIII (R. Guppy). Englishman River Falls 26-VIII-1959 (R. Guppy). Wellington VI-X (R. Guppy). Qualicum Falls 6-VIII-1951 (R. Guppy). Nanoose Creek 4-X-1951 (R. Guppy). Ucluelet 17-V-1909 (C.H. Young). Salmo Pass 5-VII-1965 (F. Schmid). Clinton 21-VI-1937 (J.K. Jacob).

Rhyacophila rotunda Banks

Rhyacophila rotunda Banks, 1924: 443.

Medium-sized species (length of front wing is 9-10 mm); front wings are dark brown, densely covered with small golden spots.

Male Genitalia (Figs. 7-9): Apicodorsal lobe of the IXth segment almost as wide as it is long. Narrow preanal appendages. Second segment of lower appendages forms a large slanted oval. Apical band forming two narrow lobes which are obtuse at the end with the two internal margins reinforced in the middle. Anal sclerites forming a trapezoid notched at the top. (Paratype from Reno, Nevada.)

Female Genitalia (Figs. 115, 118, 120): VIIIth segment looks quite elongated from the top. The apicodorsal margin has a narrow notching preceded by a long narrow groove which is itself preceded by a slight triangular keel. Vaginal apparatus is oval and rather elongated. (Specimen from Huachuca Mts, Sierra Vista, Arizona, R.F. Sternitzky.)

This species can be recognized by its very large trilobate dorsal structure.

Rh. rotunda has been found in Idaho, Utah, Colorado, California, Nevada and Arizona.

Rhyacophila tralala Schmid

Rhyacophila tralala Schmid, 1970: 142.

Medium-sized species (length of front wing is 9-11 mm); front wings are dark brown and densely sprinkled with small golden spots.

Male Genitalia (Figs. 4-6): Quite similar to those of norcuta. The only distinguishing characteristics are the apical band and anal sclerites which have a very characteristic shape. Apical band ending in two thin and pointed triangles, at the base of which are two spherical internal concavities. Anal sclerite almost entirely absent and reduced to a very small knob. (Holotype from Stimson Creek, Washington.)

Female Genitalia (Figs. 122, 124, 126): From the top, the VIIIth segment is slim and graceful. The upper end is split by a groove which extends to form a triangular depression containing a keel that is also triangular. Very simple vaginal apparatus, but less oval than that of norcuta. (Paratype from Baker Lake, Washington.)

This species is very closely connected to norcuta, but can be easily distinguished from it by the apical band ending in two tips.

Rh. tralala has not yet been captured in Canada, but it is known in several locations in the states of Washington and Oregon.

ORETA GROUP

Rhyacophila oreta Ross
Map 2

Rhyacophila oreta Ross, 1941: 39.

Small species (length of front wing is 6.5-9 mm); front wings are reddish brown with fine silver spots.

Male Genitalia (Figs. 16-17): Apicodorsal lobe of the IXth segment is long and narrow. Preanal appendages form rounded triangles that are as high as they are long. Second segment of the lower appendages forms a reverse trapezoidal shape where the apical margin is slightly concave. The aedeagus is long, very slender, and curves up to form an arc. Paramers form a band with an apicomedial row of light bristles. (Specimen from Wellington, British Columbia.)

Female Genitalia (Figs. 127-129): VIIIth segment forms a simple truncated cone with a single apicodorsal notch isolating two small triangular fins. Vaginal apparatus forms a long, very slender and simple stylet. (Specimen from Chinook Pass, Washington.)

This species is easy to recognize by its reddish brown front wings, and its very high trilobate dorsal structure. It is quite similar to but certainly distinct from basalis Banks.

Rh. oreta is widely distributed in the western areas of the continent: British Columbia, Alberta, Washington, Idaho, Wyoming, Utah, Oregon, and California. It frequents small cold and fast streams with muddy and rocky bottoms, but also springs and even rockpools. Its known period of flight extends from March to October.

British Columbia: Cultus Lake 27-III-12-X (W.E. Ricker). Wellington 17-V-12-X-1950 (R. Guppy). Englishman River Falls 26-VIII-1950 (R. Guppy). Salmo Pass 5-VII-1965 (F. Schmid). Squamish, Diamond Head Trail 3,200 ft, 3-VIII-1953 (W.R. Mason).

Alberta: Banff National Park 28-VII, 14-VIII-1949 (C.P. Alexander). Edmonton 20-VI-1952 (D.L. Carson). 7 miles W. of Banff 11-VI-1952 (C.P. Alexander).

FUSCULA GROUP

Rhyacophila fuscula (Walker)
Map 2

Neuronia fuscula Walker, 1852: 10.

Rather large robust species (length of front wing is 12-15 mm); front wings are dark brown with pretty light coloured designs along the post-costal margin, and on the arculus, and anal cells.

Male Genitalia (Fig. 84): IXth segment significantly constricted in the ventral segment. Xth segment looks like a narrow vertical band in profile. Anal sclerites large and angular. Lower appendages narrow and slender, with the second segment unnotched. Aedeagus short, bifid, and accompanied by small membranous paramers, that are erectile and bristly. (Specimen from Twin Mts., New Hampshire.)

Female Genitalia (Fig. 221): VIIIth segment massive, of complex relief, and with a pouch-shaped cavity in the dorsolateral section. Last segments short. (Specimen from Broad Run, Throughfare Gap, Virginia.)

This species can be easily recognized by its stocky appearance and the colour of the front wings.

Rh. fuscula is the most common species of this genus and the most widely spread in the eastern areas of the continent. It has been found in all the states and provinces located east of Michigan and north of Georgia: Ontario, Quebec, New Brunswick, Nova Scotia, Newfoundland, New Hampshire, Virginia, Maine, Michigan, New York, North Carolina, Pennsylvania, Tennessee, Massachusetts, Minnesota, Georgia, South Carolina, and Illinois. It inhabits all kinds of still and running streams. Its known period of flight extends from June to September.

Ontario: Arnprior IX-1920 (C. MacNamara). Algonquin Provincial Park 20-V-1955 (ROM).

Quebec: Carrière Stream, La Vérendrye Park 29-VII-1966 (F. Schmid). Knowlton 11-VII-1919 (L.J. Milne). Georgeville 29-V-19396 (G.S. Walley). Nabisipi 11-VIII-1962 (G. Shooner). Rimouski, Grenville, Mont-Tremblant Park 21-VI-25-VIII (A. Robert). St. Hippolyte Biological Station 4-VII, 9-IX-1966-1967 (F. Duranthon).

Nova Scotia: Margaree Harbour 29-VI-1936 (T.N. Freeman). Salt Springs, Pictou Co. 24-VI-1951 (C.P. Alexander).
Newfoundland: Grand Bank 2-VIII-1961 (Lindroth).

Rhyacophila vuphipes Milne
Map 2

Rhyacophila vuphipes Milne, 1936: 99.

Male Genitalia (Fig. 86): IXth segment short all around and very constricted in the ventral section. Xth segment looks like a narrow vertical band from the side and has an overhanging upper section. Anal sclerites prominent and curved downwards. Lower appendages very large, with a small very thin triangular second segment and the upper margin depressed. Phallic apparatus large, with a complex tip, and with curved small paramers that end in bristly hooks accompanied by two straight spines. (Specimen from Mont Tremblant Park, Quebec.)

Female Genitalia (Figs. 154-155, 160): VIIIth segment with the apical margin notched in the inside face. Ventral edge of the segment forms two quadrangular lobes. Vaginal apparatus oval shaped with a very complex structure. (Specimen from Mont Tremblant Park, Quebec.)

This species can be recognized by the scant development of the second segment of the lower appendages and the tip of the phallic apparatus.

Rh. vuphipes is a rare and sporadic species. It has been found in New York state, Ontario, and Quebec. The only place where I have seen specimens is the Rivière du Diable, Mont Tremblant Park VIII-1959 (A. Robert).

VAGRITA GROUP

Rhyacophila milnei Ross
Map 2

Rhyacophila milnei Ross, 1950b: 264.

Medium-sized species (length of front wing is 7.5-11.5 mm), front wings are golden with small dark spots.

Male Genitalia (Figs. 59-60): IXth segment has a very long apicodorsal lobe forming two sub-basal triangular tips ending in a long spear-shaped point. Xth segment is similarly shaped but simpler and significantly raised at the tip. The first segment of the lower appendages is not narrowed at the base. Second segment is subtriangular, with a rounded tip, and the apicodorsal margin forming a triangular fin. (Paratype from Banff, Alberta.)

Female Genitalia (Figs. 229, 232): VIIIth segment with apicolateral margins largely incised to form a short dorsal lobe and a much longer ventral point. VIII-X intersegmental membrane invaginated into the VIIIth segment over 2/3 of its length. Vaginal apparatus stretched to form a long band at the tip. (Paratype from Banff, Alberta.)

Along with vagrita, this species is one of the most original Canadian Rhyacophila in terms of the shape of its genital armature.

Rh. milnei has only been confirmed in the original location: Banff 30-VIII, 5-IX and 7-IX-1922, Alberta (C.B.D. Garrett). The description by Nimmo (1977, p. 31, Figs. 33-34) applies to a different species.

Rhyacophila vagrita Milne
Map 3

Rhyacophila vagrita Milne, 1936: 91.

Size and appearance similar to milnei.

Male Genitalia (Figs. 61-62): IXth segment with a very long apicodorsal lobe in a smooth simple band ending in two sharp points. Xth segment forming a similar band but simple and significantly shorter. The first segment of the lower appendages is short and enlarged at the tip. The second segment is arranged vertically in a narrow band where the lower section is rounded and the upper section is stretched into a long point (Specimen from Cultus Lake, British Columbia, figure by Ross).

Female Genitalia (Figs. 130-131): VIIIth segment forms a simple short tube widely notched in the apicodorsal section. VIII-X intersegmental membrane is not invaginated into the VIIIth segment. Vaginal apparatus ends in a very long and slender stylet.

This species is very similar to milnei from which it can be distinguished mainly by the bifid apicodorsal lobe of the IXth segment, and the second segment of the lower appendages which is vertically stretched.

Rh. vagrita has been found in British Columbia and Alberta, as well as in Montana and Utah.

British Columbia: Cultus Lake 24-VIII-1934 (W.E. Ricker). Skagit River, Manning Prov. Park 24-IX-1952 (D.G. Denning).

Alberta: Snaring River, Jasper National Park 3,500 ft. This station is a very large fast and turbulent river with a rocky and gravelly bottom (A.P. Nimmo).

GLABERRIMA GROUP

Rhyacophila glaberrima Ulmer
Map 3

Rhyacophila glaberrima Ulmer, 1907: 85.
Rhyacophila fairchildi Banks, 1930: 130.
Rhyacophila andrea Betten, 1934: 127.

Small species (length of front wing is 6-8 mm), front wings are uniformly dark brown.

Male Genitalia (Fig. 83): Xth segment small and forming two paired lobes which are slender and horizontal. Second segment of the lower appendages is triangular with rounded angles and without notching. Small complex aedeagus accompanied by two large ventral lobes, that are membranous and erectile, each ending in two bristly branches (Specimen from Great Smoky Mts, Tennessee).

Female Genitalia (Fig. 114): VIIIth segment barely sclerotized, with long hairs and quite short, with indistinct apicolateral margins.

This isolated species is easy to recognize by the Xth segment and the lower lobes of the phallic apparatus.

Rh. glaberrima is widely distributed east of the prairies, in Quebec, Nova Scotia, Cape Breton Island, Massachusetts, New York, North Carolina, Tennessee, New Hampshire, Georgia, and Maine. It frequents mainly small turbulent torrents with falls. Its known period of flight extends from June to August. I know of only one Canadian citation: Quebec, Mont Tremblant Park, 19-24-VII-1960 (A. Robert).

THE PHILOPOTAMOIDES BRANCH

IXth segment most often without an apicodorsal lobe. Xth segment forming a vertical band but with secondary horizontal development and even sometimes stretched into two sub-parallel horizontal branches. Preanal appendage is lost. Small and sometimes trilobate apical band. Phallic apparatus complete and massive, with a dorsal appendage, and a ventral plate or lobe, paired or unpaired.

CAROLINA GROUP

Rhyacophila carolina Banks
Map 3

Rhyacophila carolina Banks, 1911: 353.
Rhyacophila gordoni Sibley, 1926: 79.
Rhyacophila carula Denning, 1947: 660.

Rather small species (length of front wing is 7-10 mm), front wings golden with dark spots and white patches along the apical margin.

Male Genitalia (Fig. 88): Xth segment small, rather complex, and forming two short vertical fins. Second segment of the lower appendages flared and ending in two regular triangular lobes. Phallic apparatus is very large, with a small bifid aedeagus accompanied by a very large ventral plate, significantly concave at the top and with widely rounded lateral margins. Paramers erectile ending in a head with an area of dense bristles (Specimen from Great Smoky Mts, Tennessee).

Female Genitalia (Figs. 134, 137-138): VIIIth segment with very convex lateral faces and significant quadrangular dorsal notching, forming two rounded ventral lobes. Vaginal apparatus simple, oval-shaped, very elongated, and grooved to form three narrow slots (Specimen from Great Smoky Mts, Tennessee).

This species can be mainly recognized by the shape of the Xth segment, the second segment of the lower appendages, and the large ventral plate of the phallic apparatus.

Rh. carolina is widely spread in the eastern mountains of the continent. In Quebec, Maine, New Hampshire, Massachusetts, New York, Tennessee, Virginia, and North Carolina. It frequents small and medium-sized turbulent streams. Its known period of flight extends from June to October.

Quebec: Knowlton 11-VII-1929 (L.J. Milne). St. Hippolyte Biological Station 17-VI-14-IX-1966-67 (F. Duranthon). Mont Tremblant Park 15-VI-12-VIII-1958-60 (A. Robert).

ALBERTA GROUP

Rhyacophila alberta Banks
Map 3

Rhyacophila alberta Banks, 1918: 21.
Rhyacophila mirus Denning, 1948a: 21.

Medium-sized species (length of front wing is 9-10.5 mm), front wings golden and heavily sprinkled with dark spots.

Male Genitalia (Fig. 56): In profile, the Xth segment looks like a roof bulging on the top. Second segment of the lower appendages with upper apical angle almost straight, and the lower angle stretched into a rather regular narrow

oval. Paramers clearly thickened in the subapical section before attenuating gradually to form a spine. A series of strong spines are inserted into this thickened area (Specimen from Banff, Alberta).

Female Genitalia (Figs. 228, 234): The apicolateral margin of the VIIIth segment is convex and vertical with two ventral and dorsal lobes which protrude beyond the apical margin of the segment. Vaginal apparatus gradually narrowing to form a tip without a head.

This species is closely connected to tucula from which it can be distinguished mainly by the less massive shape of the second segment of the lower appendages, and paramers with more significant subapical thickening.

Rh. alberta is widely distributed in the western sectors of the continent and is centred in the Rocky Mountains, Alaska, Alberta, British Columbia, Montana, Wyoming, Colorado, and Utah. In Alberta, it populates a large number of different streams, from small to large torrents between 1,200 and 2,000 m. Its known period of flight extends from mid-August to the beginning of October.

Alberta: Lake Louise 3-VIII-1969 (C.M. Yarmolay), Nimmo 1971, Fig. 104.

Rhyacophila glaciera Denning
Map 4

Rhyacophila glaciera Denning, 1965: 263.

Rather small species (length of front wing is 8.5-9.5 mm), front wings dark with indistinct light spots.

Male Genitalia (Fig. 55): Xth segment forms an elongated regularly narrow roof up to the tip which looks slender in profile. Anal sclerites mostly rounded. Lower appendages short, with the second segment very large and divided over almost all its length by a notch isolating two angular lobes of the same width. Paramers with an upper apical area of short and fine bristles (Specimen from Cavell Creek, Alberta).

Female Genitalia (Figs. 133, 139): VIIIth segment very simple with apicolateral margins notched into a straight re-entering angle. Vaginal apparatus ending in a simple elongated lobe (Specimen from Cavell Creek, Alberta).

This species can be immediately recognized by the deep groove of the second segment of the lower appendages.

Rh. glaciera is known only in the original location in Montana and four Alberta stations: Nimmo 1971, Fig. 106. It frequents very small torrents and surface streams, and flies from the end of August to the beginning of October. Specimens have been captured moving about in the snow. The altitude distribution extends between 1,500 and 2,200 m.

Rhyacophila kincaidi Schmid
Map 4

Rhyacophila kincaidi Schmid, 1970: 157.

Medium-sized species (length of front wing is 9-11 mm), front wings are golden with many dark spots.

Male Genitalia (Fig. 57): Xth segment forms an elongated and rather thin roof. Anal sclerites are narrow. Very long lower appendages with the second segment split over half its length by a triangular notch; the two lobes formed by this notch are equally triangular and divergent. Robust paramers, with a lower apical row of short bristles (Paratype from Deception Pass, Washington).

Female Genitalia (Figs. 214, 217): VIIIth segment significantly thinner at the tip of the ventral section. Lateral faces have a shallow notch of complex shape. VIII-X intersegmental membrane invaginated into the VIIIth segment over the apical 2/3 of this segment. Vaginal apparatus ends in a long stylet with a membranous base (Specimen from Skagit River Camp, British Columbia).

This species can be easily recognized by the shape of the second segment of the lower appendages.

Rh. kincaidi has been found in Alaska, the state of Washington, and one location in British Columbia: Skagit River Camp 3-VIII-1965 (F. Schmid).

Rhyacophila tucula Ross
Map 4

Rhyacophila tucula Ross, 1950b: 261.

Medium-sized species (length of front wing 9-10 mm), front wings golden with fine dark spots.

Male Genitalia (Fig. 58): Xth segment look rather high in profile. Anal sclerites in rounded ovals. Apicodorsal margin of the second segment of the lower appendages has a shallow large notch isolating a very short dorsal lobe and a much larger thick ventral lobe. Paramers are armed with a lower apical row of short spines inserted into a scarcely thickened area (Specimen from Wellington, British Columbia).

Female Genitalia (Figs. 226, 227, 233): VIIIth segment with a slightly undulating apical margin. Ventrally, it is prolonged into a protuberant obtuse angle. VIII-X intersegmental membrane invaginated into the VIIIth segment over 2/3 of its length. Vaginal apparatus ends in a long stylet with an oval head (Specimen from Wellington, British Columbia).

This species is very similar to alberta but nevertheless clearly distinct.

Rh. tucula is very widely distributed in the western areas of the continent, but especially in the coastal ranges: Alaska, British Columbia, Alberta, Oregon, Washington, Wyoming, Idaho,, Utah. It mainly frequents small and medium-sized rapid streams with rocky bottoms above 1,200 m. Its known period of flight extends from mid-June to mid-October.

British Columbia: Wellington 22-VI-1919; 6-IX-1950 (R. Guppy). Qualicum River 12-IX-1952 (R. Guppy). Chilliwack Lake; Silver Creek; Cultus Lake 25-VIII-14-IX (W.E. Ricker). Skagit River, Manning Provincial Park 24-IX-1952 (D.G. Denning). Ketchum Lake 58° 22', 131° 45' 26-VIII-1960, 3,600 ft (W.W. Moss).

Alberta: Nimmo 1971, Fig. 105.

HYALINATA GROUP

Rhyacophila hyalinata Banks
Map 4

Rhyacophila hyalinata Banks, 1905: 10.

Rather large species (length of front wing is 11-15 mm), front wings heavily spotted with light and dark areas, with a very dark and well-defined pterostigma in the two wings.

Male Genitalia (Fig. 45): Apicodorsal section of the IXth segment clearly divided into two lobes covering only the base of the Xth segment. The latter forms

two vertical parallel bands, that are not very high. Second segment of lower appendages faintly notched with an undulating apicodorsal margin. Phallic apparatus is large and complex, and consists in large part of membranous and erectile organs (Specimen from Wildwood, Utah).

Female Genitalia (Figs. 188, 192, 194): VIIIth segment with front lateral margins very slanted. Apicolateral margins form two rather indistinct fins which are slightly angular. Apicoventral margin slightly bilobate (Specimen from O'Brien, Oregon).

This species is very close to vocala, but nevertheless quite distinct.

Rh. hyalinata is widely distributed and common in the western areas of the continent, but seems to be centred in the Rocky Mountains: British Columbia, Idaho, Utah, Wyoming, Colorado, California, and Oregon. It populates choppy streams with rocky bottoms.

British Columbia: Hope 2-VII-1965 (F. Schmid). Grand Forks 4-VII-1965 (F. Schmid). Salmo 4-VIII-1965 (F. Schmid).

Rhyacophila vocala Milne
Map 5

Rhyacophila vocala Milne, 1936: 100.
Rhyacophila hyalinata Nimmo, 1971: 27.

Rather large species (length of front wing is 11-15 mm). Front wings heavily spotted with light and dark areas, and with a very dark and well-marked pterostigma in the two wings.

Male Genitalia (Fig. 44): Apicodorsal section of the IXth segment forming a slightly bilobate roof covering the basal half of the Xth segment. The latter looks like two vertical parallel and triangular high plates, with slightly rounded angles. Second segment of the lower appendages has a large semi-circular apicodorsal notch. Phallic apparatus very close to that of hyalinata, with some small differences, such as the fact that paramers are more slender (Specimen from Koosah Falls, Oregon).

Female Genitalia (Figs. 190, 191, 193): The apicolateral margins of the VIIIth segment form two separate semi-circular fins. Ventral margin forms a large unpaired and unnotched lobe. Vaginal apparatus very large and simple and ten times longer than wide (Specimen from Koosah Falls, Oregon).

This species is very similar to hyalinata and can be distinguished from it by the characteristics listed above. Smith (1968) has questioned the validity of this species because of the existence of specimens that seem to be intermediary between vocala and hyalinata. Personally, I consider that the two species are distinct, because I have not found it difficult to distinguish all the insects that I have studied.

Rh. vocala is also widely distributed in the west of the continent, but predominates in the coastal chains: British Columbia, Alberta, Washington, Idaho, Utah, Oregon, and California. It lives in rapid streams with rocky bottoms. Its known period of flight lasts from the end of May to mid-September.

British Columbia: Cultus Lake, Fernie, East of Hope 14-VII-16-VIII (W.E. Ricker). Hope 2-VII-1965 (F. Schmid). Allison Pass 3-VII-1965 (F. Schmid). Englishman River Park 12-VIII-12-IX-1951 (R. Guppy). Mt. Benson 23-27-V-1952 (R. Guppy). Sayward 26-VI-1952 (R. Guppy). Skagit River, Manning Prov. Park 30-VII-1953 (D.G. Denning).

Alberta: Banff National Park 27-VII-1949 (C.P. Alexander). Waterton National Park, Cameron Lake 11-VIII-1949 (C.P. Alexander). Nimmo 1971, Fig. 111, under hyalinata.

COLORADENSIS GROUP

Rhyacophila bifila Banks
Map 6

Rhyacophila bifila Banks, 1914: 201.

Rather stout medium-sized species (length of front wing is 9-11 mm); blackish front wings generously spotted with white patches. There is a particularly large white area on the arculus.

Male Genitalia (Fig. 46): In profile, the Xth segment shows a heavily contoured shape with the front margin deeply notched. The second segment of the lower appendage is large with clear notching forming an obtuse angle (Specimen from Upper Grand Canyon, Yellowstone Park, Wyoming).

Female Genitalia (Figs. 184, 186): Last segments are very short. VIIIth segment has four long smooth elongations of almost equal width (Specimen from Marblemount, Washington).

This species can be easily recognized by the Xth segment, which does not have a smooth front lobe; and the second segment of the lower appendages which is rather large and clearly notched.

Rh. bifila is common and widely distributed throughout the western areas of the continent: British Columbia, Alberta, the Yukon Territory, Washington, Idaho, Montana, Wyoming, Utah, Oregon, and California. It populates a wide variety of slow or choppy streams and rivers with rocky or gravelly bottoms, between 900 and 1,500 m. Its known period of flight extends from the end of May to the end of August.

British Columbia: Cultus Lake, West of Hope (Silver Creek), W. Vancouver (Capilano River), Vernon, Walhachin 9-VII-10-VIII (W.E. Ricker). Grand Forks 4-VII-1965 (F. Schmid).

Alberta: Jasper 13-VI-1939 (E.H. Strickland). Nimmo 1971, Fig. 109.

Yukon Territory: Whitehorse 9-VIII-1948 (M.T. Hughes).

Rhyacophila coloradensis idahoensis Peck and Smith
Map 7

Rhyacophila coloradensis idahoensis Peck and Smith, 1977: 7.

Size and colouring similar to bifila.

Male Genitalia (Fig. 239): Xth segment has a very complex shape forming two long and smooth internal basal lobes that are slightly curved. First segment of the lower appendages is large and very short. Second segment particularly large, discoidal, without notching, and with a slightly depressed external face (Specimen from Robson Provincial Park, British Columbia).

Female Genitalia (Figs. 242, 243): VIIIth segment forms two large apico-dorsal lobes that are obtuse and triangular. Ventral lobes are fused over almost their entire length into a narrow plate with a short V-shaped notch at the end (Specimen from Robson Provincial Park, British Columbia).

The male genitalia of this species are practically identical to those of the typical subspecies (Fig. 47). Those of the female are different and can be recognized by the narrowness of the two fused ventral lobes.

Rh. coloradensis idahoensis is distributed throughout Alberta, eastern British Columbia, and Idaho. It frequents very choppy and rocky mountainous streams as well as slower, calmer and gravelly rivers between 900 and 1,800 m. Its known period of flight extends from the beginning of May to the end of August, with a maximum in May.

Alberta: Nimmo 1971, Fig. 110.

Rhyacophila insularis Schmid
Map 5

Rhyacophila insularis Schmid, 1970: 159.

Size and colouring similar to bifila.

Male Genitalia (Fig. 48): In profile, the Xth segment looks rather simple and ends in an oval. First segment of the lower appendages not very short. Second segment small, without notching, in the shape of a triangle with rounded angles (Paratype from Qualicum Falls, British Columbia).

Female Genitalia (Figs. 240, 241): VIIIth segment with short and wide elongations. Dorsolateral lobes are shorter than the ventral lobes, which look quadrangular from below and are almost entirely fused together. They are separated only by a small circular notch (Drawing by Peck and Smith, 1977).

This species can be recognized by the Xth segment, which shows very little scalloping and the small size of the second segment of the lower appendages.

Rh. insularis is known in two locations in British Columbia; and in Oregon and northern California.

British Columbia: Qualicum Falls 6-VIII-1951 (R. Guppy). Koksilah River 26-VII-1954 (R. Guppy).

Rhyacophila jenniferae Peck
Map 6

Rhyacophila jenniferae Peck and Smith, 1977: 9.

Size and colouring similar to bifila.

Male Genitalia (Fig. 238): Extremely similar to those of coloradensis from which it can be distinguished only by certain small details. Front basal lobe of the Xth segment less distinct. Spiniform paramers almost entirely sclerotized and membranous only at the base. Apex of the aedeagus with the upper preapical lobe a little more obtuse. Ventral lobe of the aedeagus grooved a little more deeply (Specimen from Baker Lodge, Washington).

Female Genitalia (Figs. 185, 187): These are very characteristic. VIIIth segment forms two pairs of ventral and lateral lobes which are quadrangular or rounded, barely longer than wide, and of the same size (Specimen from Baker Lodge, Washington).

The male genitalia of this species are extremely similar to those of coloradensis; while the female genitalia are very clearly different.

Rh. jenniferae is known in only one location in British Columbia, and in the states of Washington and Oregon.

British Columbia: Cultus Lake 24-VIII-1934 (W.E. Ricker).

INVARIA GROUP

Rhyacophila banksi Ross

Rhyacophila banksi Ross, 1944: 268.
Rhyacophila parantra Roy and Harper, 1975: 1081.

Rather small species (length of front wing is 9 mm), front wings dark with indistinct golden spots.

Male Genitalia (Figs. 94, 95): The apicodorsal section of the IXth segment is stretched into a protuberant lobe slanted towards the top and ending in two clearly divergent square angles. Anal sclerites small and ending in knobs. Second segment of the lower appendages has a deep apical notch isolating two distinct lobes (Original drawing by Ross, 1944).

Female Genitalia (Fig. 222): Lateral margins of the VIIIth segment have a notch that isolates a large rounded lateral lobe and a ventral plate ending in two slender points, that are divergent and distant (Original drawing by Ross, 1944).

This species can be recognized by the apicodorsal lobe of the IXth segment, and the notching of the second segment of the lower appendages.

Rh. banksi has been found in only one location in Quebec, as well as in New Hampshire and Vermont.

Rhyacophila carpenteri Milne
Map 6

Rhyacophila carpenteri Milne, 1936: 98.

Rather small species (length of front wing is 7.5-8.5 mm), front wings clearly spotted in brown and gold.

Male Genitalia (Figs. 98, 99): The apicodorsal section of the IXth segment is very slightly protuberant. The Xth segment forms a high vertical keel which is concave towards the back and looks triangular in profile. Anal sclerite large and not very prominent. Second segment of the lower appendages has a slight rounded apicodorsal notch. Phallic apparatus large, with cylindrical paramers and a few short apical bristles (Specimen from Shenandoah Nat. Park, Virginia).

Female Genitalia (Figs. 208, 215, 216): Apicolateral margin of the VIIIth segment deeply notched and forming a very prominent triangular ventral lobe. VIII-X intersegmental membrane invaginated over a section longer than the VIIIth segment. Vaginal apparatus very small.

This species can be recognized because the Xth segment looks triangular in profile, and by the shape of the second segment of the lower appendages.

Rh. carpenteri is known in Quebec, Massachusetts, Virginia, New Hampshire, New York, and North Carolina. Generally, it populates medium and sometimes very small streams. Its known period of flight extends from June to August.

Quebec: Knowlton 12-VI-1928 (J.A. Adams).

Rhyacophila invaria Walker
Map 6

Polycentropus invarius Walker, 1852: 101.
Rhyacophila luctuosa Banks, 1911: 351.

Rather small species (length of front wing is 6-7 mm), front wings brown with indistinct light spots.

Male Genitalia (Figs. 90, 91): Apicodorsal section of the IXth segment developed into a flattened trilobate lobe that is densely covered with small apical spines. Anal sclerites very large, rounded, and prominent. The apicodorsal margin of the second segment of the lower appendages has right angle notches. Spiniform paramers (Specimen from Woodstock, New Hampshire).

Female Genitalia (Figs. 218-220): VIIIth segment short with the apicolateral margin forming two large notches that isolate a short and wide dorsal lobe, a rounded lateral lobe, and a ventral lobe that is more prominent and angular. VIII-X intersegmental membrane invaginated into the VIIIth segment over almost its entire length. Vaginal apparatus (Fig. 220).

This species can be recognized by the apicodorsal lobe of the IXth segment, and the shape of the second segment of the lower appendages.

Rh. invaria is widely distributed in the eastern areas of the continent: Ontario, Quebec, Nova Scotia, Newfoundland, New Brunswick, Maine, New Hampshire, Massachusetts, New York, and Pennsylvania. It inhabits small, cold, and clear streams. Its known period of flight extends from May to August.

Ontario: Burke Falls 15-VII-1926 (F.P. Ide).

Quebec: Mont Tremblant Park 4-19-VI-1958-1960 (A. Robert).

Nova Scotia: Pleasant Bay, Cape Breton 2-VII-1951 (C.P. Alexander)

Newfoundland: Cochrane Pond Camp 30-VI-1961 (D.L. Carson). Terra Nova National Park 6-VII-1961 (M.E. Smith).

New Brunswick: Fundy National Park 22-VI-1962 (C.P. Alexander).

Rhyacophila nigrita Banks

Rhyacophila nigrita Banks, 1907: 132.

Rather small species (length of front wing is 7-9 mm), front wings uniformly dark brown.

Male Genitalia (Figs. 96, 97): Apicodorsal section of the IXth segment stretched into a wide triangular roof that is slightly notched in the middle. Xth segment forms a high vertical keel sharply concave towards the back that looks quadrangular in profile. Anal sclerites are not too large and form knobs. Second segment of the lower appendages shows notching with a very obtuse re-entering angle. Phallic apparatus large with spiniform paramers (Specimen from Smokemont, North Carolina).

Female Genitalia (Figs. 211-213): The apicolateral margin of the VIIIth segment is very slanted towards the bottom and has a small ventral lobe in the front. VIII-X intersegmental membrane invaginated into the VIIIth segment over its entire length. Vaginal apparatus (Fig. 213) (Specimen from Smokemont, North Carolina).

This species can be distinguished from other similar ones mainly on the basis of the dorsal section of the IXth segment, and the shape of the Xth segment.

Rh. nigrita has been found in Ontario, New York, North Carolina, and Tennessee. It populates small fast streams. Its known period of flight extends from May to July.

Rhyacophila vibox Milne
Map 7

Rhyacophila vibox Milne, 1936: 101.

Rather small species (length of front wing is 6-7 mm), front wings brown with indistinct spots.

Male Genitalia (Figs. 92, 93): Apicodorsal section of the IXth segment stretched into a rather short lobe ending in two somewhat divergent triangular points. Anal sclerites large, rounded, and very prominent. Second segment of lower appendages with an undulating apicodorsal margin. Phallic apparatus very large with thick paramers totally covered with bristles (Specimen from Costello Lake, Ontario).

Female Genitalia (Figs. 223-225): VIIIth segment short, rounded, with two deep dorsal and ventral notches isolating a large rounded lateral lobe. VIII-X intersegmental membrane invaginated into the VIIIth segment over more than half its length. Vaginal apparatus (Fig. 225) (Specimen from Ithaca, New York).

This species can be mainly recognized by the shape of the apical lobe of the IXth segment, and the thick and bristly paramers.

Rh. vibox is the most widely distributed species of this group in the eastern areas of the continent: Ontario, Quebec, Nova Scotia, Illinois, North Carolina, Michigan, Massachusetts, New Hampshire, New York, Vermont, and Wisconsin. It is mainly rheocrenitic. Its known period of flight extends from June to August.

Ontario: Costello Lake, Algonquin Park (W.N. Sprules).

Quebec: Chelsea 14-VI-1931 (L.J. Milne). St. Hippolyte Biological Station 8-VI-16-VII-1966-69 (F. Duranthon).

Newfoundland: Mackinson 23-VI-1961 (D.L. Carson).

ANGELITA GROUP

Rhyacophila angelita Banks
Map 7

Rhyacophila angelita Banks, 1911: 352.
Rhyacophila bipartita Banks, 1914: 201.

Medium-sized species (length of front wing is 8-11 mm), front wings dark gold mottled with small brown spots, with a lighter area with dark edges on the arculus.

Male Genitalia (Figs. 39, 40): Xth segment forms two roof-like sections overhanging the other appendages. The upper part is twice as long as the lower one and looks thin in profile; the end is notched over a third of its length. Phallic apparatus complex, with two paired ventral lobes, that are membranous and erectile with an oval-shaped apicodorsal area covered with long bristles. Dorsal appendage slightly notched at the tip (Specimen from Wellington, British Columbia).

Female Genitalia (Figs. 100-102): VIIIth segment rather truncated with a longitudinal dorsal groove. Vaginal apparatus very simple, about five times as long as wide (Specimen from Wellington, British Columbia).

This species can be recognized by its golden colour, and the complexity of the male genitalia which consist of long appendages.

Rh. angelita is very widely distributed in the west of the continent: British Columbia, Alberta, the Yukon Territory, Montana, Utah, Washington, Idaho, Oregon, Wyoming, Colorado, California and Nevada. It is also known in New Hampshire. This

very eclectic species populates all types of mountainous streams. Its known period of flight extends from the end of May to the end of November, with a maximum from July to October.

British Columbia: Courtenay, Cowichan River, Cultus Lake, West of Hope (Silver Creek) 3-VII-24-XI (W.E. Ricker). Wellington, Nanaimo, Chase River, Englishman River Falls, Koksilah River 8-VI-28-VII-1949-50 (R. Guppy). Near Lytton 8-VIII-1954 (D.G. Denning). Princeton 24-IX-1952 (D.G. Denning). Skagit River, Manning Provincial Park 24-IX-1952 (D.G. Denning).

Alberta: Banff 20-VIII, 19-IX-1946 (E.H. Strickland). Lake Louise 18, 30-VIII-1969 (C.M. Yarmolay). Nimmo 1971, Fig. 117.

Rhyacophila perplana Ross and Spencer
Map 7

Rhyacophila perplana Ross and Spencer, 1952: 44.

Rh. perplana is intermediary between angelita and vuzana. These species are so close together, that I think the perplana classification may not be valid. It is characterized by the Xth segment, which is similar to that of angelita; and the membranous lower lobes of the phallic apparatus which are similar to those of vuzana (Fig. 43).

In the female, the vaginal apparatus is a little different from those of the two above-mentioned species, being about three times as long as wide (Fig. 103).

Rh. perplana has been captured in only one location in British Columbia: Cultus Lake, also populated by angelita and vuzana. Thus, it is probable that this is a natural hybrid between these two species.

Rhyacophila vuzana Milne
Map 8

Rhyacophila vuzana Milne, 1936: 97.

Size and colouring similar to angelita.

Male Genitalia (Figs. 41-42): Dorsal section of the Xth segment slightly longer than ventral section. It looks thick in profile and is notched over a short section of the tip where it shows two circular, heavily sclerotized areas. Dorsal appendage of the phallic apparatus is not notched at the tip. Apical section of ventral lobes larger than in angelita and with a narrower and longer area of bristles (Specimen from Wellington, British Columbia).

Female Genitalia (Fig. 104): VIIIth segment similar to that of angelita. Vaginal apparatus about four times as long as wide (Specimen from Wellington, British Columbia).

This species is very similar to angelita.

Rh. vuzana has spread from British Columbia to California and Idaho.

British Columbia: Cultus Lake 9-IX-1934 (W.E. Ricker). Wellington, Nanaimo, Chase River 1-VIII-19-IX-1950 (R. Guppy). Englishman River Falls 19-IX-1950 (R. Guppy).

SIBIRICA GROUP

Rhyacophila atrata Banks
Map 8

Rhyacophila atrata Banks, 1911: 351.

Small species (length of front wing is 5-6.5 mm), front wings are uniformly black or dark brown.

Male Genitalia (Fig. 82): Xth segment small, in the shape of a simple horizontal roof. Lower appendages considerably large with two parallel margins. Second segment of the lower appendages large with straight angle notching in the upper apical angle. Aedeagus forms a very long sinuous cylinder with an area of bristles in the midline. Ventral lobe very large, membranous, and erectile, with an upper apical area of strong bristles (Specimen from Great Smoky Mts, North Carolina).

Female Genitalia (Like those in Figs. 155 and 168): VIIIth segment considerably narrowed at the tip with a concave apicolateral margin slanting towards the top. VIII-X intersegmental membrane slightly invaginated into the lower section of the VIIIth segment. Vaginal apparatus (Fig. 168).

This species is very similar to pellisa and valuma but distributed in the east.

Rh. atrata is known in Nova Scotia, North Carolina, New Hampshire, Massachusetts, and New York. It frequents the more turbulent sections of clear streams. Its known period of flight extends from May till mid-summer.

Nova Scotia: Baddeck Forks 6-VIII-1936 (J. McDunnough).

Rhyacophila belona Ross
Map 8

Rhyacophila belona Ross, 1948: 19.

Medium-sized species (length of front wings is 8-9 mm), front wings blackish and sprinkled with dark gold spots, with a larger spot on the arculus.

Male Genitalia (Figs. 67-68): Xth segment forms a long roof above the other appendages. It is not enlarged at the end but notched over half its length. The internal relief is complex and the lateral margin is not notched. Aedeagus forms an oval plate that is concave at the top and stretches into a fine apical point (Specimen from Highwood Pass, Alberta).

Female Genitalia (Figs. 180-182): The apical margins of the VIIIth segment are sculpted into complex but shallow shapes isolating two ventral lobes and two rounded dorsal lobes. VIII-X intersegmental membrane invaginated into the tip of the VIIIth segment over a short distance. Very simple vaginal apparatus (Specimen from Larch Valley, Banff National Park, Alberta).

This species is similar to vetina from which it can be distinguished by its less striking colouring and the above-mentioned genital characteristics.

Rh. belona has been found in British Columbia, Alberta, and Montana. It is a high altitude spring species that populates small torrents at altitudes between 1,800 and 2,400 m, and sometimes flies as soon as the snow melts. Its known period of flight includes June and July.

British Columbia: Robson 8-VIII-1947 (H.R. Roxlee).

Alberta: Highwood Pass 29-VI-1962, 7,900 ft (W.R. Mason). Larch Valley, Banff National Park 7-VIII-1965 (F. Schmid). Nimmo 1971, Fig. 112.

Rhyacophila blarina Ross
Map 8

Rhyacophila blarina Ross, 1941: 36.

Rather small species (length of front wing is 6.5-10 mm), front wings uniformly black.

Male Genitalia (Fig. 38): Dorsal section of the Xth segment rather complex, slanted towards the top, and ending in two rounded lobes. Second segment of the lower appendage has a very slight apical depression, and the lower margin is

mainly rounded. The aedeagus is massive and has a complex structure. The ventral lobe has a deep apical cupule containing a large brush of rough bristles (Specimen from Belfair, Washington).

Female Genitalia (Figs. 107, 113): VIIIth segment forms a regular truncated cone. Vaginal apparatus small with an oval endpiece and two distinct, short and small lateral pieces (Specimen from O'Brien, Oregon).

This species can be easily recognized by the above-mentioned characteristics.

Rh. blarina has not been captured in this country, but seems common in the states of Oregon and Washington.

Rhyacophila manistee Ross
Map 8

Rhyacophila manistee Ross, 1938a: 104.

Small species (length of front wing is 7.5 mm), front wings dark brown with indistinct light spots.

Male Genitalia (Figs. 78, 79): Xth segment forms a slanted roof twice as long as wide, that is notched over a short section of the apex with lateral margins forming two short and not very prominent fins. Second segment of the lower appendages twice as long as wide and with a slightly undulating upper margin. Ventral lobe of the aedeagus is membranous, erectile, and with a very large head which looks oval from the top. The head is very concave in the centre and has two long and almost symmetrical areas of bristles (Specimen from Ogoki, Ontario).

Female Genitalia (Similar to those on Figs. 105 and 100): VIIIth segment simple with an indistinct apical margin and a strong transversal basal keel. Vaginal apparatus ending in two lateral pieces which are longer than the central piece.

This species is very similar to minora but can be easily distinguished from it by the Xth segment and the tip of the ventral lobe of the aedeagus.

Rh. manistee is known in Ontario, Michigan, New Hampshire, and New York. It frequents clear and cold streams with variable currents, consisting of quiet ponds and faster sections. This is a spring species which flies in May and June.

Ontario: Ogoki 4-VI-1958 (J.B. Wallis).

Rhyacophila melita Ross
Map 9

Rhyacophila melita Ross, 1938a: 104.

Medium-sized species (length of front wing is 8-11 mm), front wings brown with very indistinct light spots.

Male Genitalia (Fig. 87): Xth segment forms a small roof slanted towards the back. Lower appendages large, wide, with one closely following the other; the second segment is rounded and almost entirely fused to the first. Phallic apparatus small with six smooth branches (Specimen from Montreal, Quebec).

Female Genitalia (Figs. 161-162): VIIIth segment short with apicolateral margins widely but not very deeply notched. VIII-X intersegmental membrane slightly invaginated only into the ventral section of the VIIIth segment. Last segments short. Vaginal apparatus in the shape of a simple oval (Specimen from Rupert House, Quebec).

This is an isolated species and can be distinguished from others by its large lower appendages which have indistinct segments.

Rh. melita has been captured in Quebec, Michigan, New Hampshire, and New York. It frequents rivers as well as small and larger streams with calm quiet waters. Its known period of flight seems restricted to June and July.

Quebec: Rupert House 21-VII-1949 (E.J. LeRoux). Great Whale River 15-VII-1949 (J.R. Vockeroth). Montreal, St. Helen's Island 1-10-VI-1964 (Shadfly Project). Whale River Station 10-VIII-1970-71.

Rhyacophila minora Banks
Map 9

Rhyacophila minora Banks, 1942: 444.

This species is very similar to manistee from which it can be distinguished by the following characteristics:

Male Genitalia (Figs. 80-81): Xth segment forming a shorter and wider roof notched at the tip and ending in two lobes curved towards the bottom. The lateral margins form a rounded and quite prominent fin. Second segment of the lower appendages is triangular and slightly longer than wide. Head of the lower lobe of the phallic apparatus has an irregular shape; it is very concave in the centre and notched at the tip, with two highly asymmetrical areas of bristles (Specimen from Twin Mts, New Hampshire).

Female Genitalia (Figs. 105, 111): VIIIth segment similar to that of manistee. Vaginal apparatus ending in a central piece which is longer than the lateral pieces and slightly notched at the tip (Specimen from Twin Mts, New Hampshire).

Rh. minora is very widely distributed in the eastern mountains of the continent: Nova Scotia, New Hampshire, Maine, Massachusetts, New York, North and South Carolina, and Vermont. It frequents the most turbulent sectors of small streams.

Nova Scotia: Cape Breton, Inverness Co. 5-VII-1951 (C.P. Alexander).

Rhyacophila narvae Navas
Map 9

Rhyacophila narvae Navas, 1926: 57.
Rhyacophila vepulsa Milne, 1936: 96.

Rather small species (length of front wing is 6.5-8 mm), front wings uniformly black.

Male Genitalia (Fig. 37): They are characterized by the development of the Xth segment that forms a narrow elongated bilobate roof which overhangs all the other genital organs. Lower appendages are not very long, and the second segment has a notch in the shape of an obtuse angle (Specimen from Camp Sherman, Oregon).

Female Genitalia (Figs. 132, 135): VIIIth segment very simple with apico-lateral margins forming a straight emerging angle. Vaginal apparatus is not very large; but it is elongated and membranous over half its length (Specimen from Koosah Falls, Oregon).

This species is one of the easiest to recognize because of the elongation of the Xth segment in the male.

Rh. narvae is a common and abundant species widely distributed in the western areas of the continent: British Columbia, Alberta, the Yukon Territory, Alaska, Washington, Idaho, Montana, Oregon, and California. Its ecological valence is rather large. It populates small and large rivers with gravelly bottoms, and both

slow and rapid streams between 1,200 and 1,800 m. Its known period of flight extends from May to August.

British Columbia: Cultus Lake, Manning Park, Stave Falls 20-V-9-VIII (W.E. Ricker). Cultus Lake 24-V-1965 (F. Schmid). Sandin Creek, Mile Post 578 28-VI-1952 (C.P. Alexander). Monashee Mts, Kettle River 13-VII-1949 (H.B. Leech). Crowsnest Pass 11-VII-1949, 4,500 ft (C.P. Alexander).

Yukon Territory: Alaska Highway, Mile Post 632, 28-VI-1952 (D.L. Carson).

Alberta: Banff National Park 18-VI-1952 (D.L. Carson). Livingston Creek, Kananaskis Hwy. 25-VII-1969 (R.W. Baumann). Nimmo 1971, Fig. 113, under vepulsa.

Rhyacophila pellisa Ross
Map 9

Rhyacophila pellisa Ross, 1938b: 188.
Rhyacophila doddsi Ling, 1938: 61.

Small species (length of front wing is 6-8 mm), front wings black, heavily sprinkled with large indistinct light areas.

Male Genitalia (Figs. 35, 36): Upper section of Xth segment forming a horizontal roof with two divergent points. The first segment of the lower appendages very long. Second segment much shorter with a circular incision isolating a dorsal lobe in the shape of a hook. Aedeagus is a long staff with short bristles on its basal half. Lower lobe of the aedeagus very large, with a membranous basal half and a brush of long bristles forming a cupule in the apico-dorsal region (Specimen from Rock Creek, British Columbia).

Female Genitalia (Figs. 165, 167): VIIIth segment sharply truncated with the apicolateral margins slanted towards the front and a little concave. VIII-X intersegmental membrane slightly invaginated into the lower section of the VIIIth segment. Vaginal apparatus (Fig. 167) (Specimen from Provo Canyon, Utah).

This species can be recognized by the lower appendages and the very long phallic apparatus, as well as by the Xth segment which forms divergent points.

Rh. pellisa is widely distributed in the western mountains of the continent: British Columbia, Alberta, the Yukon Territory, Washington, Idaho, Utah, Wyoming, Oregon, Colorado, and California. It frequents streams of various sizes, from small gravelly streams to rapid rivers with rocky bottoms between 1,000 and 1,800 m. Its known period of flight extends from the beginning of July to the end of August.

British Columbia: Rock Creek 4-VII-1965 (F. Schmid).

Yukon Territory: Alaska Highway, Mile Post 632 28-VIII-1952 (D.L. Carson).

Alberta: Lake Louise 27-VII-1969 (R.W. Baumann). Banff National Park 18-VI-1952 (D.L. Carson). Kicking Horse Pass 20-VII-1949, 5,350 ft (C.P. Alexander). Waterton Lakes, Indian Creek 10-VII-1949, 4,550 ft (C.P. Alexander). Nimmo 1971, Fig. 114.

Rhyacophila unimaculata Denning
Map 10

Rhyacophila unimaculata Denning, 1941: 198.

Medium-sized and rather pretty species (length of front wing is 10-12 mm); front wings are blackish, sprinkled with white spots, and with a large white patch on the arculus.

Male Genitalia (Fig. 65): Xth segment forms a very long slim dorsal branch a little enlarged at the tip where it is notched; and a ventral branch that is a little shorter and obtuse. Dorsal appendage of the phallic apparatus concave at the top. Aedeagus trifid. Ventral plate long, narrow, and spiny along the dorsal face. Second segment of the lower appendages long, narrow, and undulating (Specimen from Fernie, British Columbia).

Female Genitalia (Figs. 230, 231): Apicolateral margins of the VIIIth segment show a rather deep double notching. VIII-X intersegmental membrane invaginated into the VIIIth segment over 2/3 of its length. Vaginal apparatus in the shape of a large oval.

This species is one of the prettiest nearctic Rhyacophila. It can be recognized by the elongation of the genital armature.

Rh. unimaculata is known only in two locations in British Columbia: Robson 16-IV-1969 (H.R. Foxlee); amd Fernie 17-V-1965 (F. Schmid). It frequents small torrential streams at low altitudes and flies early in the spring, as soon as the snow melts.

Rhyacophila valuma Milne
Map 10

Rhyacophila valuma Milne, 1936: 100.

Size and colouring similar to pellisa.

Male Genitalia (Figs. 33, 34): Very similar to those of pellisa but easy to recognize on the basis of two characteristics: the dorsal section of the Xth segment does not form two points but a single lobe slightly notched at the tip. Ventral lobe of the aedeagus has a brush of much thicker long bristles (Specimen from Belknap Spring, Oregon).

Female Genitalia: They are impossible to distinguish from those of pellisa on the basis of external characteristics, but the vaginal apparatus is a little different (Fig. 166) (Specimen from Clearwater Creek, Oregon).

Rh. valuma is known in British Columbia, Alberta, Washington, Utah, Oregon, Colorado, and California. It lives mainly in turbulent small streams, and its known period of flight extends from the end of May to the end of September.

British Columbia: Cultus Lake 23-VII-25-VIII (W.E. Ricker). Cultus Lake 24-V-1965 (F. Schmid). Wellington 21-IX-1951 (R. Guppy). Sayward 26-VI-1952 (R. Guppy). Nimpkisch River 24-VI-1952 (R. Guppy). Allison Pass 3-VII-1965 (F. Schmid).

Alberta: Pipestone River, near Lake Louise 22-VIII-1954 (D.G. Denning).

Rhyacophila vetina Milne

Rhyacophila vetina Milne, 1936: 91.

Pretty, medium-sized species (length of front wing is 8-9 mm), front wings are blackish and sprinkled with light grey and golden spots, with a large light grey patch on the arculus.

Male Genitalia (Figs. 69, 70): Xth segment forms a long roof above the other appendages. It is enlarged and notched over a third of its length. Near the base, the lateral margins show a deep semi-circular incision. Second segment of the lower appendages shows a deep right angle notch which isolates a lower lobe in the shape of a large oval. Phallic apparatus has a voluminous base. Aedeagus in

the shape of a plate, concave on the top and ending in three points: two short lateral points and a longer centre point (Specimen from Chinook Pass, Washington).

Female Genitalia (Figs. 169, 175, 176): The apical margin of the VIIIth segment forms two quadrangular lateral lobes and two oval ventral lobes. VIII-X intersegmental membrane slightly invaginated into the tip of the VIIIth segment. Vaginal apparatus simple and elongated (Specimen from Chinook Pass, Washington).

This species can be recognized by its pretty black, golden, and light grey colour; the shape of the Xth segment, and the notching in the second segment of the lower appendages.

Rh. vetina is a high altitude spring species that has been captured in the states of Washington and Oregon, but not in Canada.

VOFIXA GROUP

Rhyacophila iranda Ross

Rhyacophila iranda Ross, 1938a: 103.

Rather small species (length of front wing is 8-8.5 mm), front wings uniformly brown.

Male Genitalia (Fig. 76): Xth segment rather small, of simple shape, and slanted towards the bottom and back. Anal sclerites slightly bilobate. Second segment of the lower appendages enlarged towards the tip and with the posterior margin slightly concave. Aedeagus small but slim and bifid, with the dorsal branch clearly thicker at the apex than at the base. Paramers slightly arched, slim, and with short spinules (Holotype from Mt Baker, Washington).

Female Genitalia (Figs. 183, 189): VIIIth segment rather deeply notched on the dorsal section, with undulating lateral margins, and forming two very obtuse swellings. VIII-X intersegmental membrane invaginated into almost half of the length of the VIIIth segment. Vaginal apparatus (Fig. 189).

This species can be mainly recognized by the shape of the second segment of the lower appendages.

Rh. iranda has been found only in the states of Washington and Oregon.

Rhyacophila ophrys Ross
Map 10

Rhyacophila ophrys Ross, 1948: 19.
Rhyacophila simplex Nimmo, 1977: 27.

Small species (length of front wing is 6.5-7.5 mm), front wings dark brown.

Male Genitalia (Fig. 75): Xth segment in the shape of a short roof slanted towards the top, incised along the apical margin, and triangular in profile. Second segment of the lower appendages large, without incision, in the shape of a triangle with bulging sides. Aedeagus small and slim. Paramers membranous and erectile, with a voluminous erectile, rounded, and bristly head (Paratype from Logan Pass, Montana).

Female unknown.

This species can be mainly recognized by the convex shape of the second segment of the lower appendages.

Rh. ophrys is known in only one location in Montana. Recently, it has been redescribed in Alberta by Nimmo, under the name simplex. A comparison between the holotype of the latter and the ophrys paratype shows only minimum differences, which should not be considered species-related characteristics.

Alberta: Ruby Creek, Waterton National Park 29-VI-1975 (D.B. Donald).

Rhyacophila vobara Milne
Map 10

Rhyacophila vobara Milne, 1936: 94.

Rather small species (length of front wing is 7.5-8.5 mm), front wings brown with gold spots.

Male Genitalia (Fig. 74): Xth segment small and with a simple quadrangular shape; the apical margin is vertical and a little undulating. Anal sclerites are bilobate. Second segment of the lower appendages is square, with a straight apicodorsal angle, and the apicoventral angle stretched into a short triangle. Aedeagus small, bifid, with an upper branch of regular width, and a lower branch forming a blunt point. Paramers small with a few short spinules (Specimen from Whitehorse, Yukon Territory).

Female Genitalia (Figs. 163, 164, 170): Apical margin of the VIIIth segment notched on the dorsal section and forming a rounded and not very deep re-entering angle along the lateral section. VIII-X intersegmental membrane invaginated over a short section of the VIIIth segment. Vaginal apparatus simple, with a large terminal piece split at the end (Specimen from Lake Louise, Alberta).

This species is mainly characterized by the shapes of the Xth segment and the second segment of the lower appendages.

Rh. vobara has been captured in British Columbia, Alberta, the Yukon Territory, and Idaho. It frequents small rapid and turbulent alpine torrents and gravelly streams, as well as deep, calm, and peaty streams. Its known period of flight extends from the beginning of July to mid-September, between 1,000 and 1,800 m.

British Columbia: Revelstoke Mt. 12-VIII-1923, 6,000 ft. (E.R. Buckell). Cultus Lake (W.E. Ricker). Salmo Pass 5-VII-1965 (F. Schmid).

Alberta: Moraine Lake 2-VIII-1949, 3,000 ft (C.P. Alexander). Bow Pass 21-VII-1949, 6,288 ft (C.P. Alexander). Banff National Park 28-VII-1949, 4,525 ft (C.P. Alexander). Nimmo 1971, Fig. 115.

Yukon Territory: Whitehorse 23-VI-1950 (W.R. Richards). Alaska Highway, Mile Post 933 4-VII-1952 (D.L. Carson).

Rhyacophila vofixa Milne
Map 11

Rhyacophila vofixa Milne, 1936: 95.

Medium-sized species (length of front wing is 11-12 mm), front wings are dark brown with indistinct light spots.

Male Genitalia (Fig. 77): Apicodorsal section of the IXth segment slightly stretched into a roof above the base of the Xth segment. The latter looks like a plate slanted towards the back, concave in the centre, and with lateral margins significantly raised. Second segment of the lower appendages has a clear apical notch isolating the dorsal from the ventral angle, which are both triangular, but of very different sizes. Phallic apparatus small. Aedeagus bifid, with the dorsal branch clearly thicker than the ventral branch. Paramers in the shape of short lobes equipped with a row of spines.

Female Genitalia (Figs. 171, 174): VIIIth segment rather elongated and with a deep longitudinal dorsal groove. Apical margin undulating and forming two triangular and rounded lateral lobes and an unpaired ventral lobe. VIII-X intersegmental membrane invaginated into almost half the length of the VIIIth segment. Vaginal apparatus forming a large curve in profile.

This species can be distinguished from others by its Xth segment, which is concave at the top; and the shape of the second segment of the lower appendages.

Rh. vofixa has been captured in British Columbia, Alberta, the Yukon Territory, Alaska, Washington, and Idaho. It has significant ecological valence because it populates very turbulent small torrents as well as calm waters with rapid currents between 600 and 2,000 m. Its known period of flight extends from mid-July to the end of August.

British Columbia: N. Forb, Tetra River, Alaska Highway, Mile Post 392 3-VIII-1952 (C.P. Alexander).

Alberta: Waterton Lakes 17-VIII-1946 (M.E. Smith). Nimmo 1971, Fig. 107.

BETTENI GROUP

Rhyacophila chilsia Denning
Map 11

Rhyacophila chilsia Denning, 1950: 116.

Small species (length of front wing is 8.5 mm), front wings are dark slightly speckled with light spots.

Male Genitalia (Fig. 52): Apicodorsal section of the IXth segment slightly enlarged into an indistinct lobe. In profile, the Xth segment looks like an irregular band slanted towards the bottom. Anal sclerite forms a slim triangle also slanted towards the bottom. Second segment of the lower appendages is quadrangular, elongated, and truncated at the tip, with the upper angle incised and forming a small acute lobe. Phallic apparatus includes a large dorsal appendage with the tip curving up, a thick aedeagus ending in two branches of unequal length, and two long slim paramers ending in several points (Specimen from Cultus Lake, British Columbia).

Female Genitalia (Figs. 196-198): VIIIth segment high and short, constricted in the apical ventral section and with a heart-shaped lobe in this location. Vaginal apparatus slim and ending in two fused lobes which gradually become thinner.

This species can be recognized by the slanting Xth segment, and the shape of the second segment of the lower appendages.

Rh. chilsia is known only in British Columbia, Alberta, and Oregon.

British Columbia: Cultus Lake 12-IX-1937 (W.E. Ricker).

Alberta: Maligne Canyon, Jasper National Park 23-VII-1949 (C.P. Alexander).

Rhyacophila fenderi Ross

Rhyacophila fenderi Ross, 1948: 18.

Small species (length of front wing is 6.5-8.5 mm), front wings are dark brown, slightly tinted with gold.

Male Genitalia (Fig. 54): Apicodorsal section of the IXth segment forming a pointed lobe which dominates the other genital organs. Xth segment looks like a vertical rectangle in profile, with two sharp internal teeth. Anal sclerite is desclerotized. Apicodorsal margin of the second segment of the lower appendages is a little undulating. The external face is concave and forms a very chitinous lower basal keel. Phallic apparatus consists of a dorsal appendage that is trilobate at the end, a robust but short and bifid aedeagus, and two long paramers ending in two teeth (Specimen from Peavine Ridge, Oregon).

Female Genitalia (Figs. 200-202): The apical margin of the VIIIth segment is slightly slanted. It forms a rather indistinct ventral lobe shaped like a regular oval. VIII-X intersegmental membrane invaginated over 2/3 of the length of the

VIIIth segment. Vaginal apparatus ending in two slim stylets (Specimen from Prospect, Oregon).

This species can be mainly characterized by the apicodorsal lobe of the IXth segment, and the concave external face of the second segment of the lower appendages.

Rh. fenderi has been found only in the states of Washington, Oregon, and California.

Rhyacophila malkini Ross
Map 11

Rhyacophila malkini Ross, 1947: 126.

Medium-sized species (length of front wing is 10-14 mm), front wings dark brown heavily sprinkled with very fine light spots.

Male Genitalia (Fig. 53): Apicodorsal section of the IXth segment stretched into a long tongue at the end of which can be found the Xth segment which is reduced to a miniscule knob when viewed from the side. Paired anal sclerites are also very small. The second segment of the lower appendages quadrangular, with slightly depressed lower and apical margins. Phallic apparatus consists of an elongated dorsal appendage, a small and bifid aedeagus, and an unpaired paramer with strong apical bristles (Specimen from Qualicum River, British Columbia).

Female Genitalia (Figs. 203, 204): Apicolateral margins of the VIIIth segment with heavy triangular notching extending toward the front and forming a keel over almost the entire length of the segment. VIII-X intersegmental membrane invaginated into the apical third of the VIIIth segment only. Vaginal apparatus ends in two large obtuse fused lobes (Specimen from Wellington, British Columbia).

This species is very characteristic in terms of the stretching of the apicodorsal section of the IXth segment and the reduction of the Xth segment.

Rh. malkini is known only from Vancouver Island and Oregon. It frequents large streams and flies mainly in the autumn.

British Columbia: Wellington 15-IX-15-X-1949-50 (R. Guppy). Nanaimo, Millstone River 26-IX-1950 (R. Guppy). Qualicum Falls 12-IX-1952 (R. Guppy).

Rhyacophila perda Ross
Map 11

Rhyacophila perda Ross, 1938a: 105.

Medium-sized species (length of front wing is 9.5-12 mm), front wings are dark brown sprinkled with small golden spots.

Male Genitalia (Fig. 71): Complex and massive. Xth segment in the shape of a slanted plate bent towards the back with ear-shaped raised lateral margins and a midline keel developed mainly towards the tip. Second segment of the lower appendages has a concave external face and forms a clear basal and frontal keel ending in a strong horizontal spine in the dorsal position. Aedeagus massive and complex, accompanied by a slender and unpaired long paramer (Specimen from Mineral Park, Washington).

Female Genitalia (Figs. 205-207): Apicodorsal margin of the VIIIth segment largely arched towards the bottom and heavily fringed. Ventrally, it forms a rather indistinct horizontal lobe which is suddenly constricted over its apical third. VIII-X intersegmental membrane invaginated over more than half the length of the VIIIth segment. Vaginal apparatus (Fig. 207) (Specimen from Mineral Park, Washington).

This species can be immediately recognized by the external relief of the second segment of the lower appendages.

Rh. perda is distributed from southern British Columbia to Oregon and seems to be specially localized in the Cascade Range. It seems to frequent very turbulent small streams.

British Columbia: Cultus Lake 26-VII-1934 (W.E. Ricker). Squamish, Diamond Head Trail 10-VIII-1953, 3,600 ft (G.J. Spencer).

Rhyacophila vaccua Milne
Map 12

Rhyacophila vaccua Milne, 1936: 94.
Rhyacophila complicata Ling, 1938: 60.
Rhyacophila bruesi Milne and Milne, 1940: 154.

Medium-sized species (length of front wing is 10-12.5 mm), front wings are dark brown and sprinkled with small gold spots.

Male Genitalia (Fig. 51): Xth segment looks like a very thick plate concave in the centre of its upper face and prolonged into a bifid anal sclerite. Second segment of the lower appendages rather small and with complex apical relief; it ends in three more or less coalescing lobes. Phallic apparatus of considerable size consisting of an elongated dorsal appendage, a robust and slightly bifid aedeagus, and a long unpaired paramer with a bristly tip (Specimen from Wellington, British Columbia.

Female Genitalia (Figs. 209, 210): Apicolateral margin of the VIIIth segment is very gradually attenuated towards the tip. Ventrally, it forms a well-defined bifid appendage. VIII-X intersegmental membrane invaginated up to the base of the VIIIth segment. Vaginal apparatus rather complex (Specimen from Wellington, British Columbia).

This species is easy to recognize by the shape of the Xth segment and that of the second segment of the lower appendages.

Rh. vaccua is widely distributed in the western sectors of the continent, where it is common and abundant: British Columbia, Alberta, Washington, Montana, Idaho, Wyoming, Oregon, and California. It has very significant ecological valence, and frequents streams of all sizes, calm or turbulent, between 1,000 and 1,800 m. Its known period of flight extends from August to October, with a predominance in September and October.

British Columbia: Cultus Lake 25-VIII-1934 (W.E. Ricker). Fitzgerald 21-VIII-1921 (W.R. Carter). Keremos, Shingle Creek Road 8-IX-1934 (A.N. Gartrell). Wellington, Englishman River Falls, Nanaimo, Chaise River, Nanoose Creek, Nanoose Bay, Mt. Benson VII-X-1948-51 (R. Guppy). Skagit River, Manning Provincial Park 24-IX-1952 (D.G. Denning).

Alberta: Lake Louise 22-VIII-1969 (C,M. Yarmolay), Banff National Park, 7 miles W. 14-VIII-1949 (C.P. Alexander). Nimmo 1971, Fig. 116.

Rhyacophila vedra Milne

Rhyacophila vedra Milne, 1936: 97.

Medium-sized species (length of front wing is 8-11 mm), front wings dark greyish-brown heavily but indistinctly sprinkled with light spots.

Male Genitalia (Fig. 64): IXth segment significantly stretched in the apical section and reaching the tip of the first segment of the lower appendages. Xth segment located at the end of the IXth and reduced to a minuscule knob. Phallic

apparatus almost entirely contained in the dorsal section of the IXth segment. Second segment of the lower appendages long, subquadrangular, with slightly concave upper and lower margins, and a slanted and bulging apical margin (Specimen from Fort Ross, California).

Female Genitalia (Figs. 195, 199): VIIIth segment remarkably robust, with vertical and slightly undulating apicolateral margins. Ventrally, it forms a large slightly bifid tongue. VIII-X intersegmental membrane invaginated up to the upper margin of the VIIIth segment. Vaginal apparatus (Fig. 199) (Specimen from Wonder, Oregon).

This species is unique by the extreme stretching of the apicodorsal section of the IXth segment and the small size of the Xth segment.

Rh. vedra is known only in the states of Washington, Oregon and California. The four species recently separated from vedra by Denning (1975) (cerita Denning, californica Ling, arcella Denning, and tehama Denning) are not really distinct species.

VERRULA GROUP

Rhyacophila autumnalis Nimmo
Map 12

Rhyacophila autumnalis Nimmo, 1977: 30.

Medium-sized species (length of front wing is 9.4 mm), front wings heavily sprinkled with fine light and dark spots.

Male Genitalia (Fig. 32): Apicodorsal lobe of the IXth segment rather large with the tip in the shape of a straight truncated cone preceded by a large depression. Xth segment forms a large horizontal plate slightly notched at the tip. Second segment of the lower appendages forms an acute triangle with a slightly undulating apicodorsal margin. Dorsal appendage of the phallic apparatus slender and clearly dilated at the top. Ventral lobe has an elongated oval-shaped head, grooved over its entire length, and with two long symmetrical areas of strong bristles (Holotype from Rowe Bk, Waterton National Park, Alberta).

Female unknown.

This species is rather similar to rickeri, from which it can be mainly distinguished by the apicodorsal lobe of the IXth segment, and the shape of the Xth segment.

Rh. autumnalis is known only in the original location: Rowe Bk., Waterton National Park 24-VIII and 12-IX-1975. It inhabits rocky and gravelly streams, between 1,800 and 2,200 m and flies from the end of August to mid-September.

Rhyacophila rickeri Ross
Map 12

Rhyacophila rickeri Ross, 1956: 120.

Medium-sized species (length of front wing is 11-12 mm), front wings are greyish, finely sprinkled with light spots.

Male Genitalia (Fig. 31): IXth segment has an apicodorsal lobe which overhangs the Xth segment. The latter has a complex shape; it is only slightly protuberant, and forms two triangular lobes in the upper position. Second segment of the lower appendages forms an elongated triangle. Ventral lobe of the aedeagus is large and short with two internal brushes of apical bristles (Specimen from Mt Edith Cavell, Jasper National Park, Alberta).

Female Genitalia (Figs. 244, 245): VIIIth segment short, slightly sclerotized, with a very indistinct apical margin apparently notched laterally and dorsally. Vaginal apparatus ending in a very large oval-shaped piece, topped by a rod-shaped lobe that is notched over a short section of the tip (Specimen from Mount Edith Cavell, Jasper National Park, Alberta).

This species should not be classified into the sibirica group, as I did in 1970, but into the verrula group. This is based upon the general configuration of the male genitalia (which I had misinterpreted), and the closed midline cell of the lower wings.

Rh. rickeri frequents very small moraine streams at high altitudes (2,200 m). It flies in October, and can occasionally be captured on the snow.

British Columbia: Babine River, 50 m N. Hazelton (W.E. Ricker).

Alberta: Nimmo 1971, Fig. 112.

Alaska: Reed Creek, Snow Bird Mine, Talkeetna Mts near Palmer 12-X-1950 (D.A. Sleeper).

Rhyacophila verrula Milne
Map 13

Rhyacophila verrula Milne, 1936: 90.
Rhyacophila oregonensis Ling, 1938: 62.

Medium-sized species (length of front wing is 11-15 mm), its colouring is rather unique. Head and legs are light red and the body brown. Front wings reddish-orange, with well-defined large brown spots. Internal posterior spur of the male has an attached hairy subapical lobe.

Male Genitalia (Fig. 49): Apicodorsal section of the IXth segment forms a large appendage that is bifid at the tip and curves to form a hook above the other appendages. Lower appendages slim with the second appendage in the shape of a simple and elongated oval. Ventral lobe of the phallic apparatus uniformly sclerotized and forming a V-shaped sheath at the aedeagus which is shaped like a fine sword (Specimen from Nanoose Creek, British Columbia).

Female Genitalia (Figs. 106, 108): VIIIth segment long, glabrous and with very indistinct anterior and posterior margins. Vaginal apparatus ends in a long stylet with an erectile basal half (Specimen from Wellington, British Columbia).

This species has very characteristic genitalia. Its lively speckled colouring is similar to that of the scorpion fly.

Rh. verrula is very common and widely distributed in the western areas of the continent: British Columbia, Alberta, the Yukon Territory, Alaska, Washington, Idaho, Montana, Wyoming, Colorado, Utah, Oregon, and California. Its very wide ecological valence allows it to populate all types of running water, provided that the streams are rather turbulent, and located between 900 and 1,200 m. Its known period of flight extends from May to October, with a maximum from August to September.

British Columbia: Atlin 22-VII-1955 (H. Huckel). Hope Mts 28-VIII-1931 (A.N. Gartrell). Wellington VI-X-1950 (R. Guppy). Englishman River Falls 26-VIII-1950 (R. Guppy). Nanoose Creek 4-X-1951 (R. Guppy), Cultus Lake 12-18-VIII-1934 (W.E. Ricker).

Alberta: Waterton Lakes, Cameron Creek 18-VIII-1928 (J. McDunnough). Nimmo 1971, Fig. 118.

Yukon Territory: Alaska Highway, Mile Post 932 29-VII-1952 (C.P. Alexander).

THE DIVARICATA BRANCH

IXth segment with an apicodorsal lobe. Xth segment significantly reduced or absent. Preanal appendages large and fused to anal or vestigial sclerites and integrated into the base of the latter. Anal sclerites large, prominent, horizontal, and sometimes replacing the absent Xth segment. Apical band lost. Phallic apparatus without dorsal appendage or ventral lobe. Paramers large and erectile.

TORVA GROUP

Rhyacophila torva Hagen
Map 13

Rhyacophila torva Hagen, 1861: 296.
Rhyacophila terminata Banks, 1907: 132.
Rhyacophila vinura Milne, 1936: 100.

Rather small species (length of front wing is 7-8 mm), front wings uniformly blackish brown.

Male Genitalia (Fig. 85): Apicodorsal lobe of the IXth segment very large and horizontal. Xth segment reduced to two small vestigial pieces on either side of the base of the IXth segment. First segment of the lower appendages short, with complex internal relief. Second segment clearly longer than the first and forming a rectangle with rounded angles. Aedeagus bifid over a significant portion of its length. Spiniform paramers (Specimen from Keene, New York).

Female Genitalia (Figs. 136, 140): Apical and upper margins of the VIIIth segment rather indistinct, forming a long undulating line. Vaginal apparatus suboval and rather complex.

This is an isolated species easy to recognize by the length of the second segment of the lower appendages.

Rh. torva is very widely distributed in the eastern areas of the continent, but rarely abundant locally: Quebec, Nova Scotia, Newfoundland, New York, Massachusetts, New Hampshire, Tennessee, Virginia, Maine, New Jersey, North and South Carolina, and the District of Columbia. It mainly inhabits large streams with fast rapids. It is a spring species with a known period of flight extending from May to July.

Quebec: St. Jovite, Mont Tremblant Park 19-V-20-VII (A. Robert).
Nova Scotia: Kentville 1-VII-1924 (R.P. Gorham).
Newfoundland: Bonne Bay 10-VI-1961 (D.L. Carson).

VEMNA GROUP

Rhyacophila gemona Ross

Rhyacophila gemona Ross, 1938b: 117.

Large species (length of front wing is 16 mm), front wings brown, heavily sprinkled with irregular light spots. Particularly, there are large light spots before the pterostigma, on the arculus, and on the centre of the anal cells.

Male Genitalia (Figs. 25, 26): Preanal appendages form a heart-shaped figure that is wider than long. Anal sclerites with very slanted margins and a significantly notched top. Second segment of lower appendages almost as high as long. Lower margin of the first segment forms a prominent and rather acute basal angle (Holotype from Mt Baker, Washington).

Female unknown.

This species is very close to robusta and can be recognized by the shape of the dorsal unit, and the lower basal angle of the lower appendages.

Rh. gemona has not been captured in this country and is known only in a small number of locations in the state of Washington.

Rhyacophila robusta Schmid
Map 14

Rhyacophila robusta Schmid, 1970, p. 205.

Large species (length of front wing is 16-19 mm); colour of front wings similar to gemona.

Male Genitalia (Figs. 21, 22): Preanal appendages twice as long as wide, clearly distant one from the other, and with slightly convex lateral margins. Anal sclerites slightly narrowed at the tip and with a large apical notch topped by a fin. Second segment of the lower appendages twice as long as high, with a slightly concave apical margin. Lower margin of the first segment with a basal angle so obtuse that it is barely noticeable (Holotype from Banff, Alberta).

Female unknown.

This species is very close to vemna and gemona and is distinguished from them by the shape of the dorsal unit and that of the lower appendages.

Rh. robusta is known only in two original locations in British Columbia and Alberta. It populates very turbulent streams.

British Columbia: Kitchener 19-V-1965 (F. Schmid). Vernon VIII (ex. coll. Banks)

Alberta: Banff, Bungalow Camp Creek 5-VI-1957 (W.E. Ricker).

Rhyacophila vemna Milne
Map 14

Rhyacophila vemna Milne, 1936: 92.

Large species (length of front wing is 13-16 mm), colouring similar to that of gemona.

Male Genitalia (Figs. 23, 24): Preanal appendages longer than wide, not heart-shaped, with very convex lateral margins that are clearly wider than the anal sclerites. The latter are barely notched at the tip. Second segment of the lower appendages forms a pointed oval one and a half times as long as wide. Lower margin of the first segment with a barely noticeable and very obtuse angle (Specimen from Mt Adams, Washington).

Female Genitalia (Figs. 141-143): VIIIth segment with a slight transversal basal keel followed by a narrowed area and then a slight bulge; the apicodorsal margin is indistinct. Vaginal apparatus with lateral pieces forming narrow and regular bands twice as long as the terminal piece (Specimen from Mt Adams, Washington).

This species is similar to gemona and robusta and can be distinguished from them by the shape of the dorsal unit and that of the lower appendages.

Rh. vemna is known in British Columbia, Alberta, Washington, Idaho, and Oregon. It populates small rapid mountain torrents with gravelly bottoms. The known period of fligh extends from mid-May to mid-July.

British Columbia: Logan Pass 5-VIII-1949 (J.H. Baker).

Alberta: Banff National Park, Larch Valley 7-VII-1965 (F. Schmid). Waterton National Park, Trail to Rowe Lake 55-6500, 17-VI-1961 (H.E. Milliron). Nimmo 1971, Fig. 120.

ACROPEDES GROUP

Rhyacophila acropedes Banks
Map 15

Rhyacophila acropedes Banks, 1914: 201.

Medium-sized species (length of front wing is 9-12 mm), front wings dark greyish-brown, densely and regularly sprinkled with small gold spots.

Male Genitalia (Fig. 29): IXth segment has a sharp apicodorsal point overhanging the anal sclerites. The latter are not very long but slightly curved towards the top. Second segment of the lower appendages has apical notching almost in straight angles ending in a rather obtuse triangular lobe. Lower margin of the first segment with a large incision isolating a straight basal angle (Specimen from Camp Sherman, Oregon).

Female Genitalia (Figs. 156-158): Lower apical section of the VIIIth segment very strongly pinched to form a keel with slightly concave faces and a rounded tip longer than the apical margin of this segment. Vaginal apparatus (Fig. 158) (Specimen from Lost Prairie, Oregon).

This species is mainly characterized by the shape of the lower appendages.

Rh. acropedes is very widely distributed in the mountains of the neararctic west: British Columbia, Alberta, the Yukon Territory, the Northwest Territories, Washington, Idaho, Montana, Utah, South Dakota, Wyoming, Oregon, Nevada, Colorado, and California. It populates all kinds of running water between 750 and 2,200 m and flies during the entire period of warm weather.

British Columbia: Rock Creek 4-VII-1965 (F. Schmid). Salmo 4-VII-1965 (F. Schmid). Hosmer Creek 8-VII-1949 (H.B. Leech).

Alberta: Nimmo 1971, Fig. 108.

Yukon Territory: Dawson, Rock Creek 26-VIII-1949, 3,600 ft (P.F. Bruggeman). Alaska Highway, Mile Post 632 23,30-VI-1932 (C.P. Alexander).

Northwest Territories: Mackenzie River 7-VII-1947 (L.O. Townsend).

Rhyacophila grandis Banks
Map 14

Rhyacophila grandis Banks, 1911: 350.
Rhyacophila vohrna Milne, 1936: 94.

Large, rather stout species (length of front wing is 12-17 mm), front wings densely and regularly sprinkled with rather large gold spots.

Male Genitalia (Fig. 28): IXth segment with a rather large apicodorsal lobe covering the base of the anal sclerites. The latter are almost as long as the lower appendages, raised at the tip, and with a slightly rounded lower apical margin. Second segment of the lower appendages is triangular with a slightly depressed apical margin. The first segment is larger at the base and attenuates gradually at the tip (Specimen from Belfair, Washington).

Female Genitalia (Figs. 147, 148): VIIIth segment very short, rather thick, and with a laterally and ventrally indistinct apical margin. Vaginal apparatus consists of a terminal piece and two very long and cylindrical lateral pieces that are membranous lengthwise along the midline (Specimen from Wellington, British Columbia).

This species is easy to recognize because of its large size and the long anal sclerites that are raised at the tip.

Rh. grandis is known in British Columbia, Washington, Oregon, and California. It is common and abundant, especially in the Cascade Range. It mainly populates small streams, even when they are intermittent. Its known period of flight extends from the beginning of June to September.

British Columbia: Bon Accord, Cultus Lake, Vancouver, Vernon 14-VI-15-VIII (W.E. Ricker). Wellington, Nanaimo, Chase River, Millstone River 8-VI-9-IX-1949 (R. Guppy). Mt Cobely 10-VIII-1948 (R. Guppy).

Rhyacophila ignorata Schmid
Map 15

Rhyacophila ignorata Schmid, 1974: 933.
Rhyacophila acropedes Auctorum.

This species is altogether similar to acropedes in size, colouring, and male genitalia. It is distinguished from that species only by the female genitalia and its geographical distribution.

Female Genitalia (Figs. 150, 152, 159): Lower apical angle of the VIIIth segment is clearly pinched into a keel where the faces are not concave and the tip is angular, barely longer than the tip of the segment. Vaginal apparatus (Fig. 159) (Holotype from Mt Washington, New Hampshire).

This species is not clearly distinct from acropedes; however, I have isolated it on the basis of the female genitalia, and especially in view of its clear geographical isolation.

Rh. ignorata is widely distributed in the eastern areas of the continent: Ontario, Quebec, Maine, Michigan, New Hampshire, and New York. It populates medium-sized very turbulent streams, and flies especially in July and August.

Quebec: Bradore Bay 12-VII-1930 (W.J. Brown). Knob Lake 54°47', 66°47' 12-VII-1948 (E.G. Munroe). Rivière aux Feuilles 16-VII-15-VIII (B. Jessop).

Ontario: Blue Jay Cove, Manitoulin Isl. 30-VI, 8-VII-1957 (F.P. Ide).

Rhyacophila inculta Ross and Spencer
Map 15

Rhyacophila inculta Ross and Spencer, 1952: 43.

Medium-sized species, indistinguishable from acropedes in terms of size and colouring.

Male Genitalia (Fig. 27): VIIIth segment with a sharp apicodorsal point dominating the anal sclerites. The latter are rather regularly rectangular, with rounded angles. The second segment of the lower appendages form an obtuse triangle with a slightly incised apical margin and the end forming an obtuse rounded lobe. The lower margin of the first segment without a clear re-entering or emerging angle, but significantly undulating (Specimen from Koksilah River, British Columbia).

Female Genitalia (Figs. 149, 151, 153): Apical margin of the VIIIth segment straight. Apicoventral angle pinched to form a rather clear keel where the top is sharp and protruding above the apical margin of the segment. Vaginal apparatus (Fig. 153) (Specimen from Hope, British Columbia).

This species can be mainly distinguished from vao and acropedes by the shape of the lower appendages.

Rh. inculta is known in British Columbia, Washington, Oregon, and California. Its known period of flight extends from mid-May to mid-October.

British Columbia: Cultus Lake 23-VII-1936, 18-V-1933 (H.H. Ross and W.E. Ricker). Vancouver 20-VII-1936 (H.H. Ross). Nanoose Creek 11-X-1951 (R. Guppy). Nimpkish River 24-VI-1952 (R. Guppy). Koksilah River 26-VII-1954 (R. Guppy). Hope 2-VII-1965 (F. Schmid).

Rhyacophila vao Milne
Map 16

Rhyacophila vao Milne, 1936: 93.
Rhyacophila vu Milne, 1936: 93.

Medium-sized species, indistinguishable from acropedes in terms of size and colouring.

Male Genitalia (Fig. 30): IXth segment without an apicodorsal point overhanging the anal sclerites. The latter are rather long and their lower apical angle is very rounded. The second segment of the lower appendages is triangular, with the apical margin slightly depressed and a pointed end. Lower margin of the first segment has a large circular notch isolating an angle that is less obtuse than in acropedes.

Female Genitalia (Figs. 144-146): Apicolateral margins of the VIIIth segment are slightly undulating. The apicoventral section is slightly pinched to form a barely protuberant keel that is visible only from the bottom. Vaginal apparatus (Fig. 146).

This species is easy to distinguish from acropedes by the absence of the apicodorsal point of the IXth segment, and the second segment of the lower appendages in the shape of a pointed triangle.

Rh. vao is common and widely distributed in the western areas of the continent: British Columbia, Alberta, Alaska, Washington, Idaho, Montana, and Oregon. It populates small gravelly and rocky streams with medium currents. Its known period of flight extends from the end of May to the end of September, between 750 and 2,000 m.

British Columbia: Cultus Lake 8-VIII-1934 (W.E. Ricker). Manning Provincial Park (W.E. Ricker). Cultus Lake 24-V-1965 (F. Schmid). Rock Creek 4-VII-1965 (F. Schmid). Hope 2-VII-1965 (F. Schmid). Salmo Pass 5-VII-1965 (F. Schmid). Skagit River Camp 3-VII-1965 (F. Schmid). Grand Forks 4-VII-1965 (F. Schmid). Skagit River, near Manning Provincial Park 30-V-1953 (D.G. Denning). Sicamous Creek, near Salmon Arm 20-VIII-1954 (D.G. Denning).

Alberta: Nimmo, 1977, Fig. 110.

Alaska: Fort Yukon 30-VI-1916 (J.A.Kutsche).

THE NAVICULATA BRANCH

IXth segment short and with a very large apicodorsal lobe. Xth segment large, horizontal, and invaginated into the base of the IXth segment. Preanal appendages lost. Anal sclerites large. Apical band simple. Phallic apparatus long and slender and reduced to an aedeagus and paramers.

LIEFTINCKI GROUP

Rhyacophila arnaudi Denning
Map 16

Rhyacophila arnaudi Denning, 1948b: 97.

Medium-sized species (length of front wing is 9-11 mm), front wings are reddish-brown and have a very large pale area bordered with dark at the arculus.

Male Genitalia (Fig. 63): IXth segment elongated in the apicodorsal region to form a large horizontal plate that is concave in the lower face and ends in two sharp points. In profile, the tip of the Xth segment looks subquadrangular and has several small apical teeth. The second segment of the lower appendages is not well-differentiated from the first, it is triangular in shape, and has a slight notch just after the upper angle. Phallic apparatus consists of the aedeagus and two long and slim paramers (Specimen from Yakima River, Washington).

Female Genitalia (Figs. 109, 116): VIIIth segment in the shape of a very simple truncated cone with vertical apicolateral margins. Vaginal apparatus ending in a tongue that is erectile over its basal half (Specimen from Hope, British Columbia).

This species can be recognized by the significant roof-like elongation of the apicodorsal section of the IXth segment.

Rh. arnaudi is distributed in British Columbia, Oregon, Washington, and northern California. It is especially frequent in fast-running streams.

British Columbia: Hope 23-V-1965 (F. Schmid).

Incertae sedis

Rhyacophila alexanderi Denning

Rhyacophila alexanderi Denning, 1950: 115.

Small species (length of front wing is 8 mm), front wings uniformly brown. III to VI abdominal tergites have a circular tubercule covered with long hairs (Fig. 73).

Male Genitalia (Fig. 72): Xth segment consists of several fins of complex relief with a prominent anal sclerite curved towards the bottom. Lower appendages with two segments of subequal size and quadrangular shape. Upper margin of the second segment with a very clear triangular tooth (Drawings by Ross, 1956).

Female unknown.

This isolated species is apparently unrelated to others. It is known only in the typical location in Montana.

Rhyacophila vaefes Milne
Map 15

Rhyacophila vaefes Milne, 1936: 96.
Rhyacophila vujuna Milne, 1936: 99.

Rather small species (length of front wing is 7.5-9 mm), front wings olive brown sprinkled with spots that are a little lighter.

Male Genitalia (Fig. 50): Xth segment forms a large roof above the other appendages, at the tip of which can be found the anal sclerite which is shaped in the form of a thick unpaired vertical plate. The second segment of the lower appendages is elongated, almost triangular, and with the upper margin slightly depressed at the base. Phallic apparatus in the shape of a capsule, made up of two rectangular lateral pieces fringed at the tip and containing the aedeagus itself (Specimen from Wellington, British Columbia).

Female Genitalia (Figs. 177, 179): VIIIth segment significantly truncated with the apicolateral margins forming a straight re-entering angle. Vaginal apparatus ending in two thick lateral pieces with the tip shaped like a pointed arch (Specimen from Mineral Park, Washington).

This is an isolated species recognizable on the basis of its roof-like Xth segment and the large vertical anal sclerite.

Rh. vaefes is a common species in the western areas of the continent but has a rather restricted distribution: British Columbia, Washington, Oregon, and California. It frequents medium-sized, very turbulent streams. Its known period of flight extends from June to Septemberp.

British Columbia: Cultus Lake 25-VIII-1934 (W.E. Ricker). Allison Pass 3-VII-1965 (F. Schmid). Wellington 15-VI-31-IX-1950 (R. Guppy).

Rhyacophila visor Milne
Map 16

Rhyacophila visor Milne, 1936: 101.

Small species (length of front wing is 6-7.5 mm), front wings are uniformly olive brown.

Male Genitalia (Fig. 66): Xth segment rather massive and made up of two large triangular lateral lobes curving a little towards the inside. Lower appendages moderately long. Second segment large and with an undulating apicodorsal margin. Phallic apparatus simple, composed of a phallotheca with an apicodorsal margin that stretches into a hook-shaped spine. Aedeagus small, simple, and slender (Specimen from Timberline Lodge, Oregon).

Female Genitalia (Figs. 172, 173, 178): The lateral margins of the VIIIth segment have a deep semi-circular notch isolating two dorsal lobes and one ventral lobe, all three slightly convergent. Vaginal apparatus complex and mostly oval-shaped (Specimen from Timberline Lodge, Oregon).

This is an isolated species and is mainly characterized by the shape of the Xth segment.

Rh. visor has been captured in British Columbia, Washington, and Oregon. It is located in the Cascade Range and coastal chains. Its known period of flight extends from June to August.

British Columbia: Cultus Lake 12-VIII-1934 (W.E. Ricker).

Nomina dubia

The following species are classified as nomina dubia. The types are lost and nothing is known about their characteristics.

Rhyacophila brunnea Banks, 1911, p. 352.
Rhyacophila mainensis Banks 1911, p. 354.
Rhyacophila pacifica Banks 1895, p. 316.
Rhyacophila soror Provancher 1878, p. 135.

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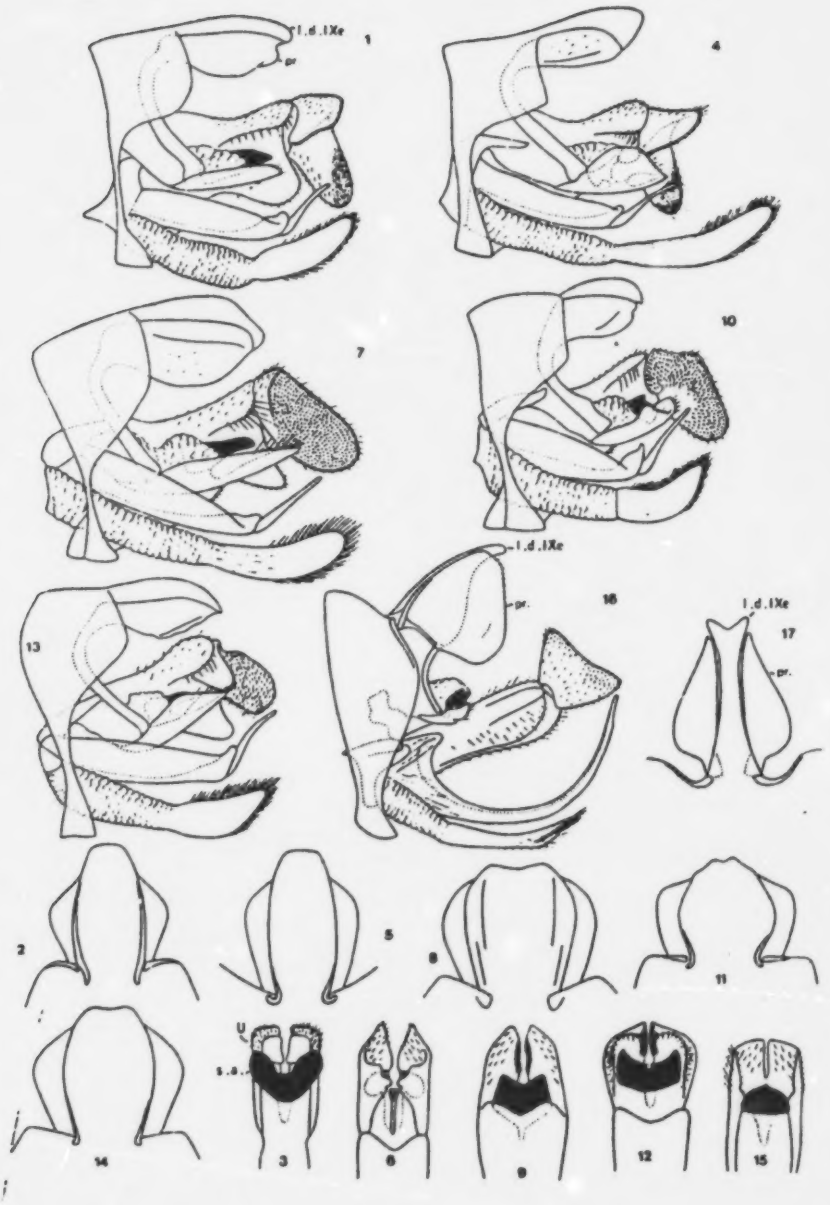
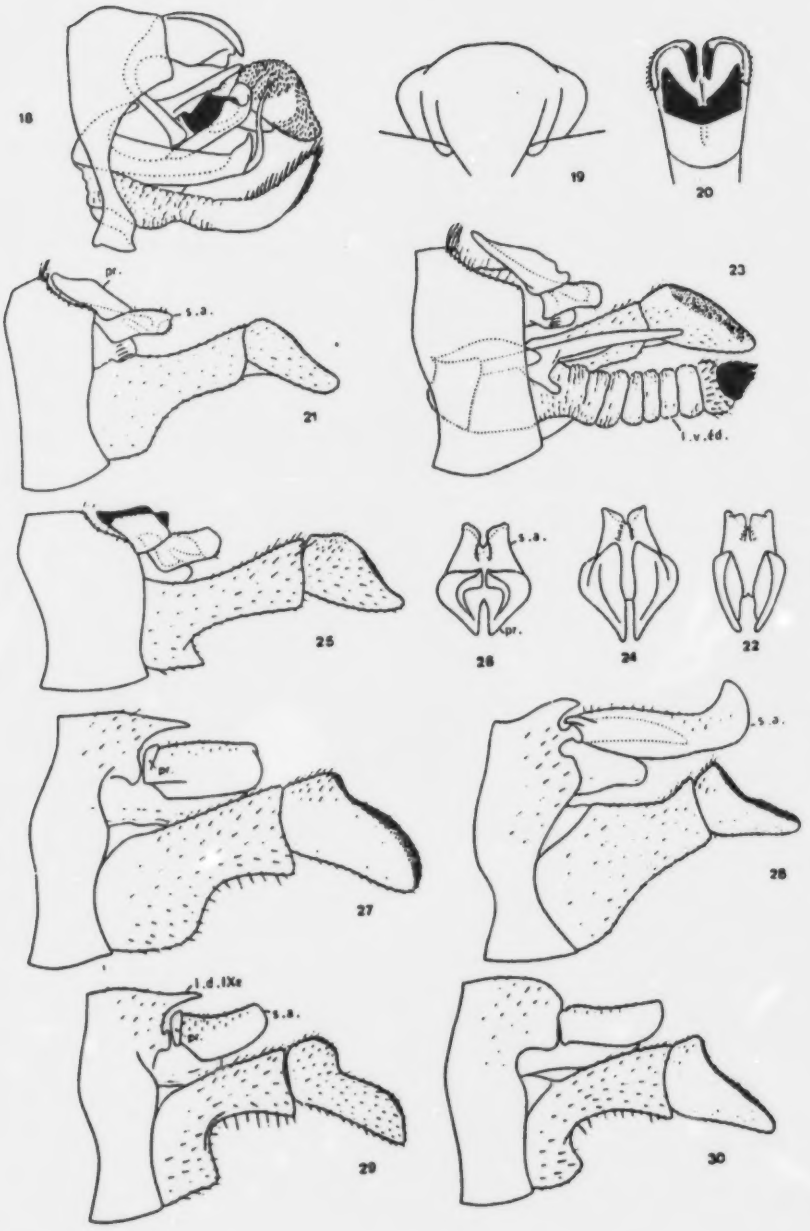
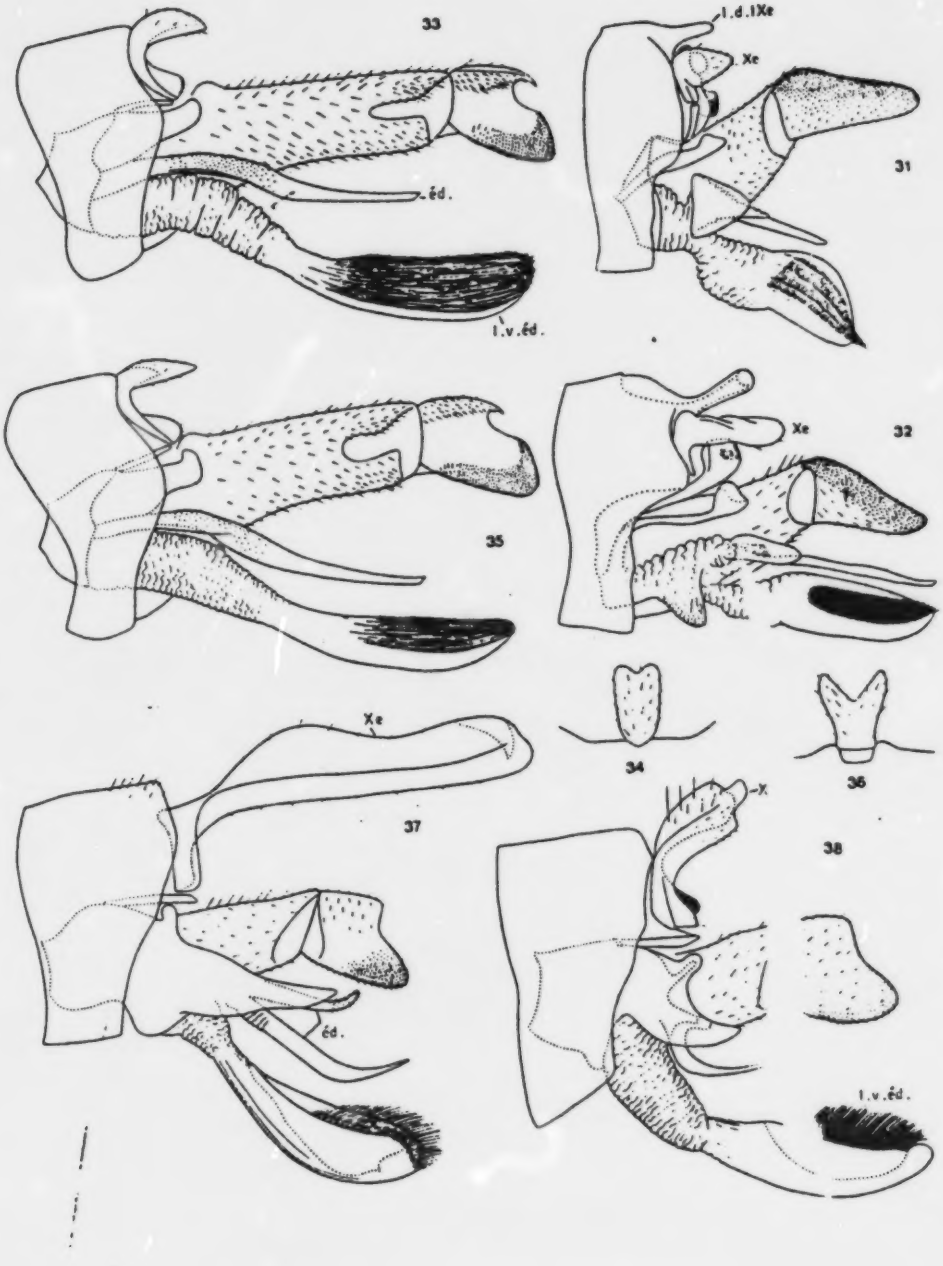


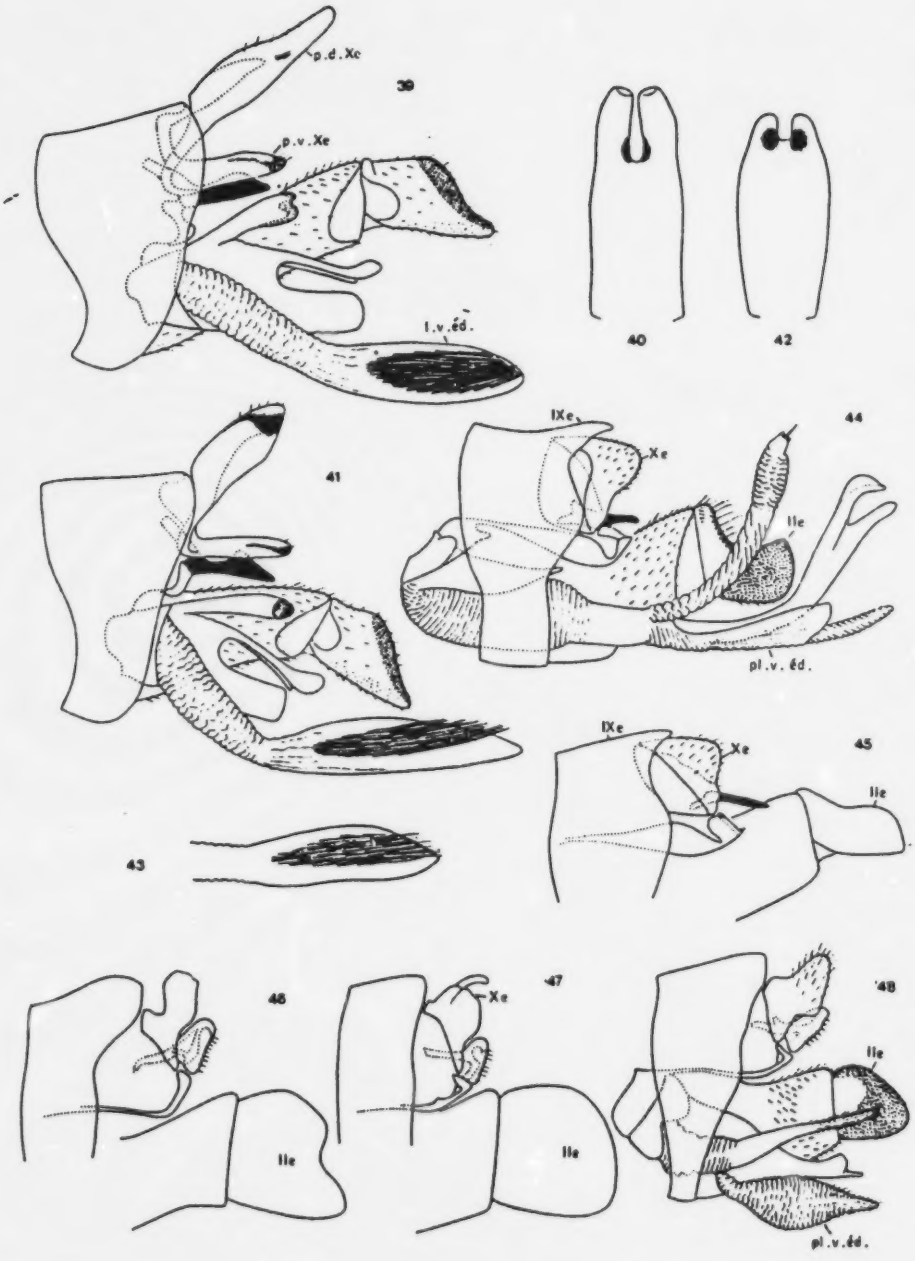
FIGS. 1-17. 1-3, Rh. norcuta: 1, male genitalia in profile; 2, dorsal unit from above; 3, apical band (U) from above; 4-6, Rh. tralala: 4, male genitalia in profile; 5, dorsal unit from above; 6, apical band (U) from above; 7-9, Rh. rotunda: 7, male genitalia in profile; 8, dorsal unit from above; 9, apical band (U) from above; 10-12, Rh. ebria: 10, male genitalia in profile; 11, dorsal unit from above; 12, apical band (U) from above. 13-15, Rh. latitergum: 13, male genitalia in profile; 14, dorsal unit from above; 15, apical band (U) from above; 16-17, Rh. oreta: 16, male genitalia in profile; 17, dorsal unit from above.



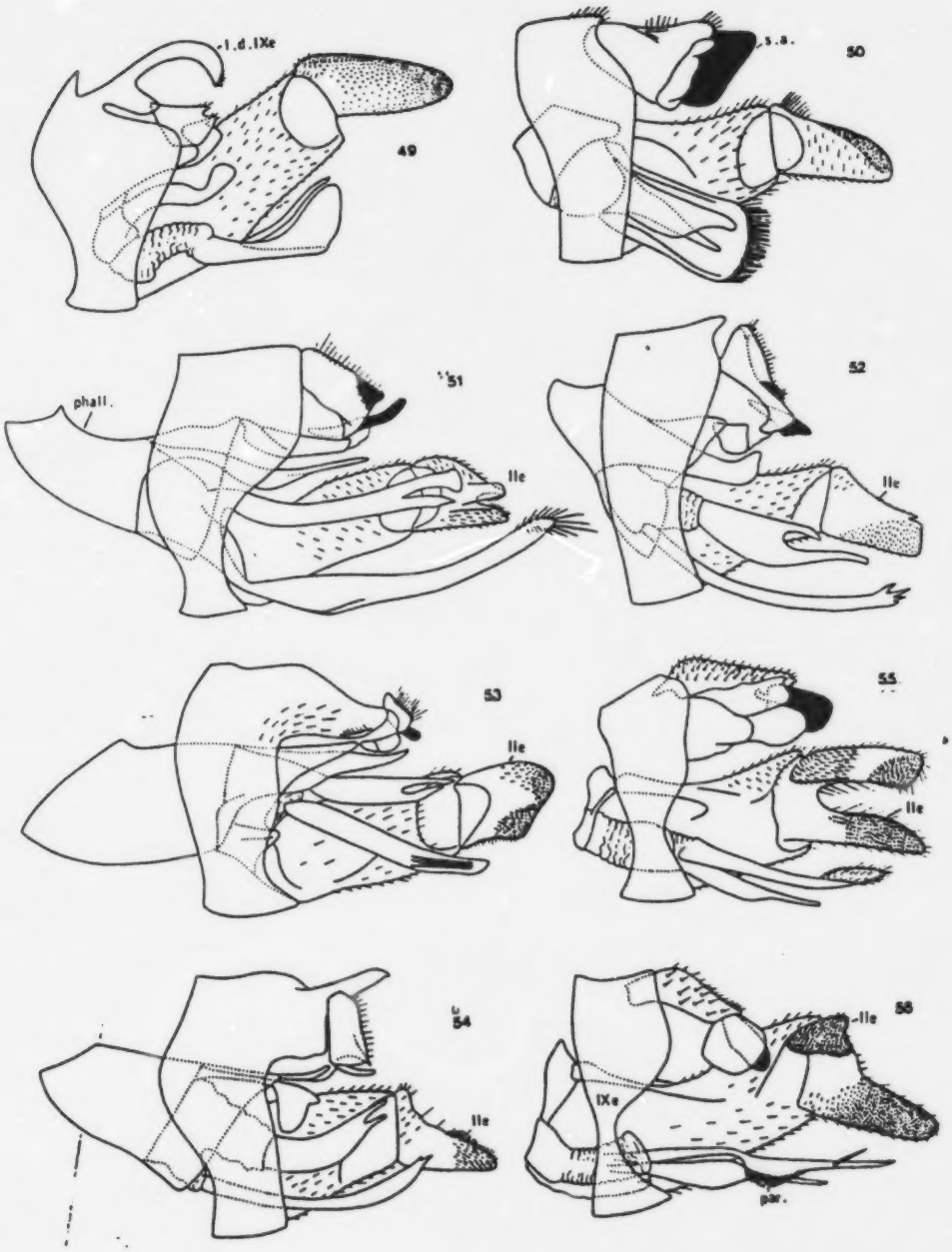
FIGS. 18-30. 18-20, Rh. donaldi: 18, male genitalia in profile; 19, dorsal unit from above; 20, apical band (U) from above; 21-22, Rh. robusta: 21, male genitalia in profile; 22, dorsal unit from above. 23-24, Rh. vemna: 23, male genitalia in profile; 24, dorsal unit from above. 25-26, Rh. gemona: 25, male genitalia in profile; 26, dorsal unit from above. 27, Rh. inculta, male genitalia in profile. 28, Rh. grandis, male genitalia in profile. 29, Rh. acropedes, male genitalia in profile. 30, Rh. vao, male genitalia in profile.



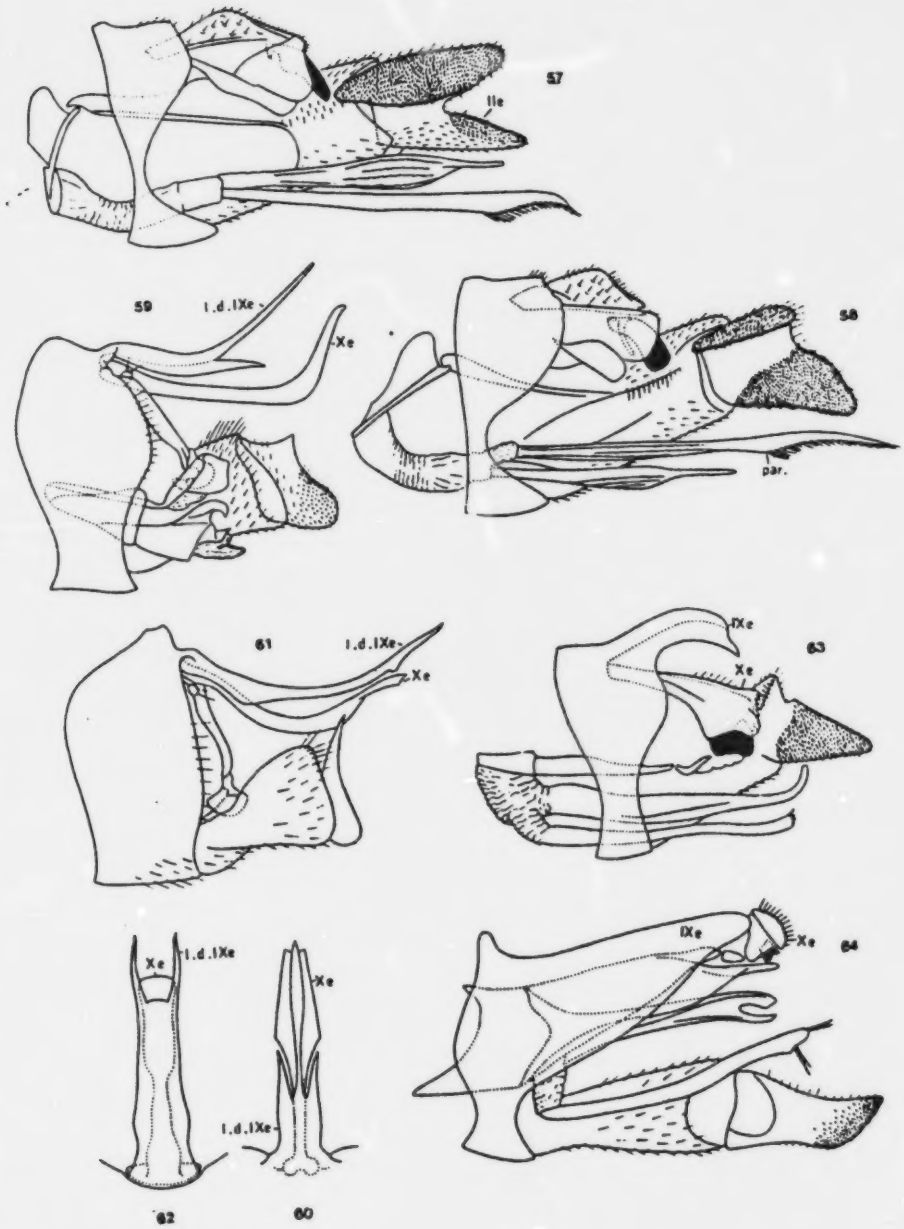
FIGS. 31-38. 31, Rh. rickeri, male genitalia in profile. Fig. 32, Rh. autumnalis, male genitalia in profile. 33-34, Rh. valumna: 33, male genitalia in profile; 34, Xth segment from above. 35-36, Rh. pellisa: 35, male genitalia in profile; 36, Xth segment from above. 37, Rh. narvae, male genitalia in profile. 38, Rh. blarina, male genitalia in profile.



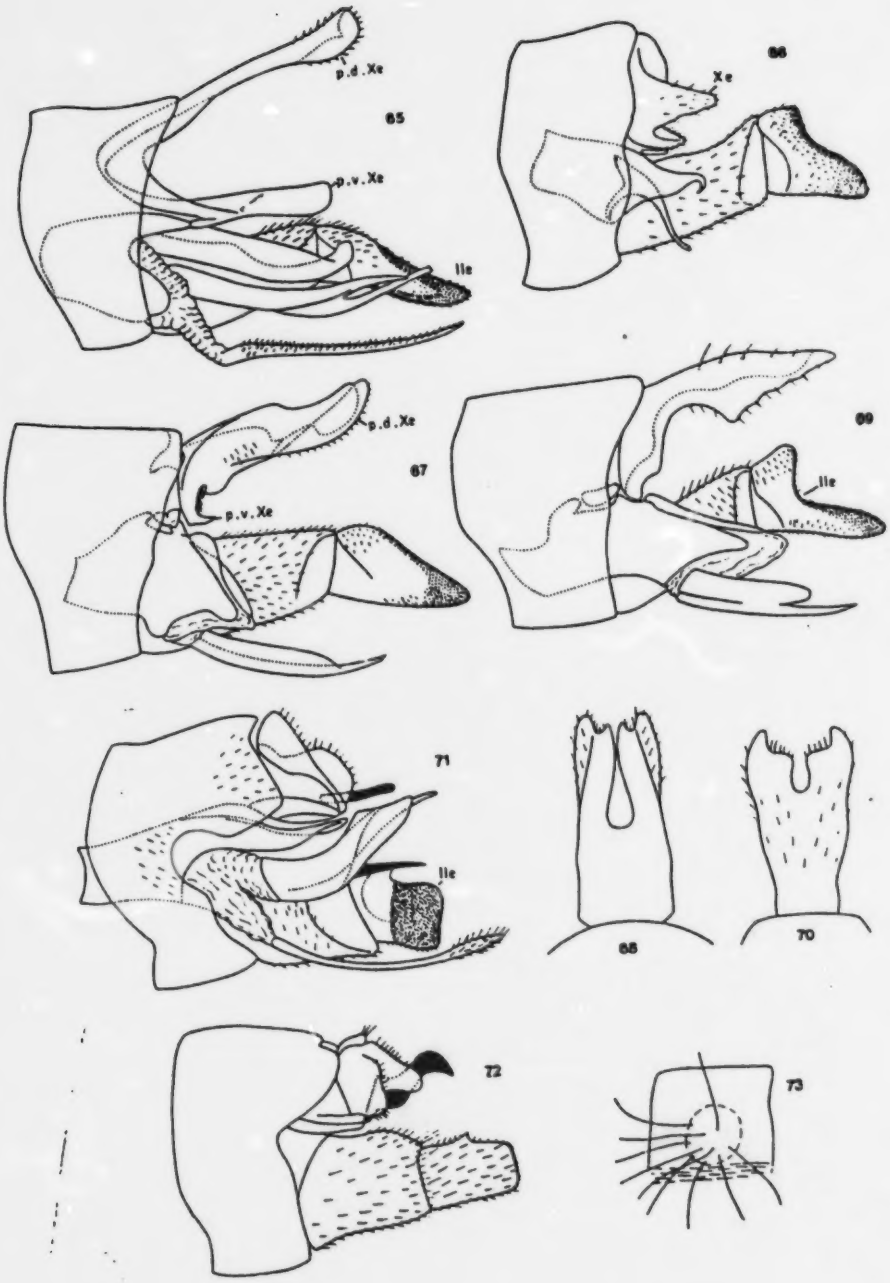
FIGS. 39-48. 39-40, Rh. angelita: 39, male genitalia in profile; 40, Xth segment from below. 41-42, Rh. vuzana: 41, male genitalia in profile; 42, Xth segment from below. 43, Rh. perplana, apex of the ventral lobe of the aedeagus in profile. 44, Rh. vocala, male genitalia in profile. 45, Rh. hyalinata, male genitalia in profile. 46, Rh. bifila, male genitalia in profile. 47, Rh. coloradensis coloradensis, male genitalia in profil 48, Rh. insularis, male genitalia in profile.



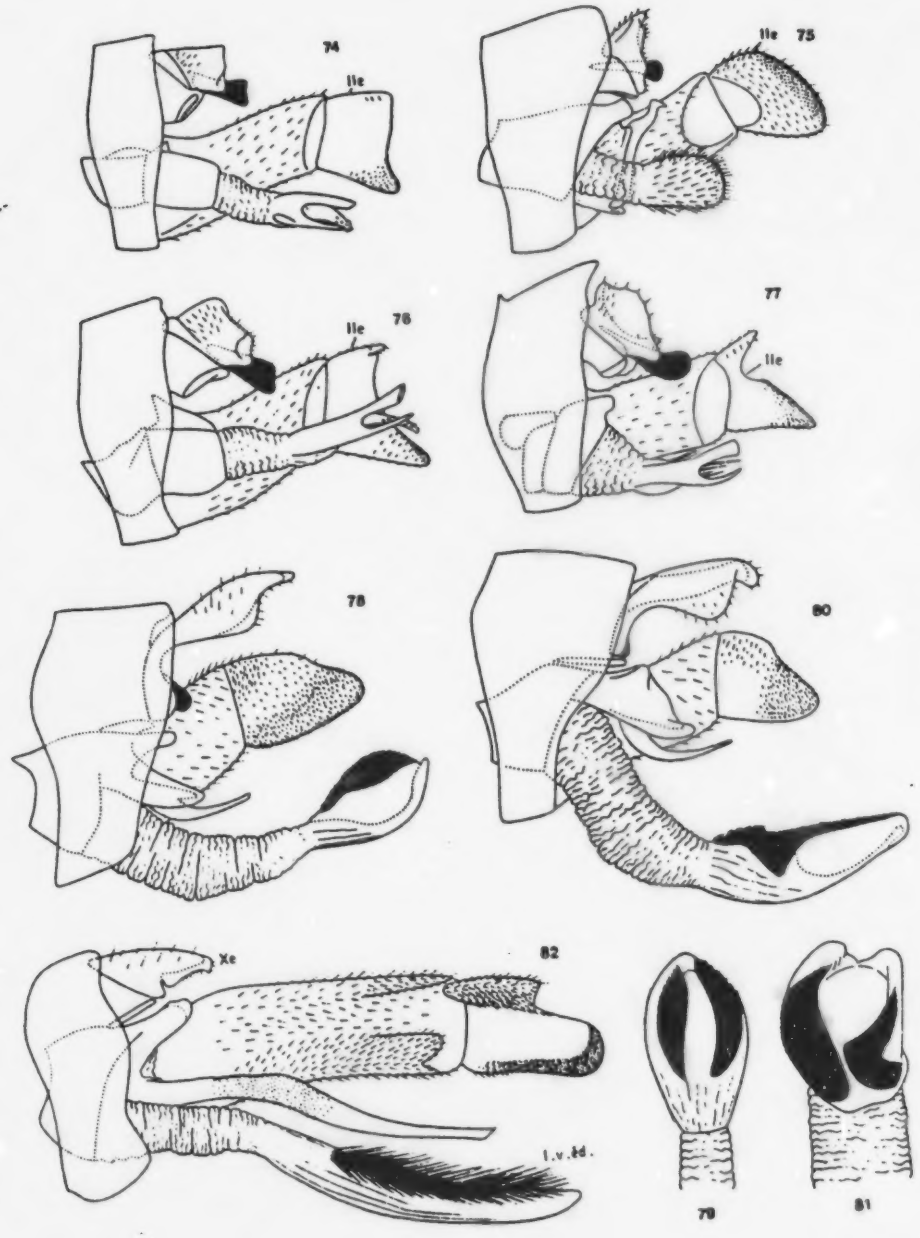
FIGS. 49–56. 49, Rh. verrula, male genitalia in profile. 50, Rh. vaefes, male genitalia in profile. 51, Rh. vaccua, male genitalia in profile. 52, Rh. chilsia, male genitalia in profile. 53, Rh. malkini, male genitalia in profile. 54, Rh. fenderi, male genitalia in profile. 55, Rh. glaciera, male genitalia in profile. 56, Rh. alberta, male genitalia in profile.



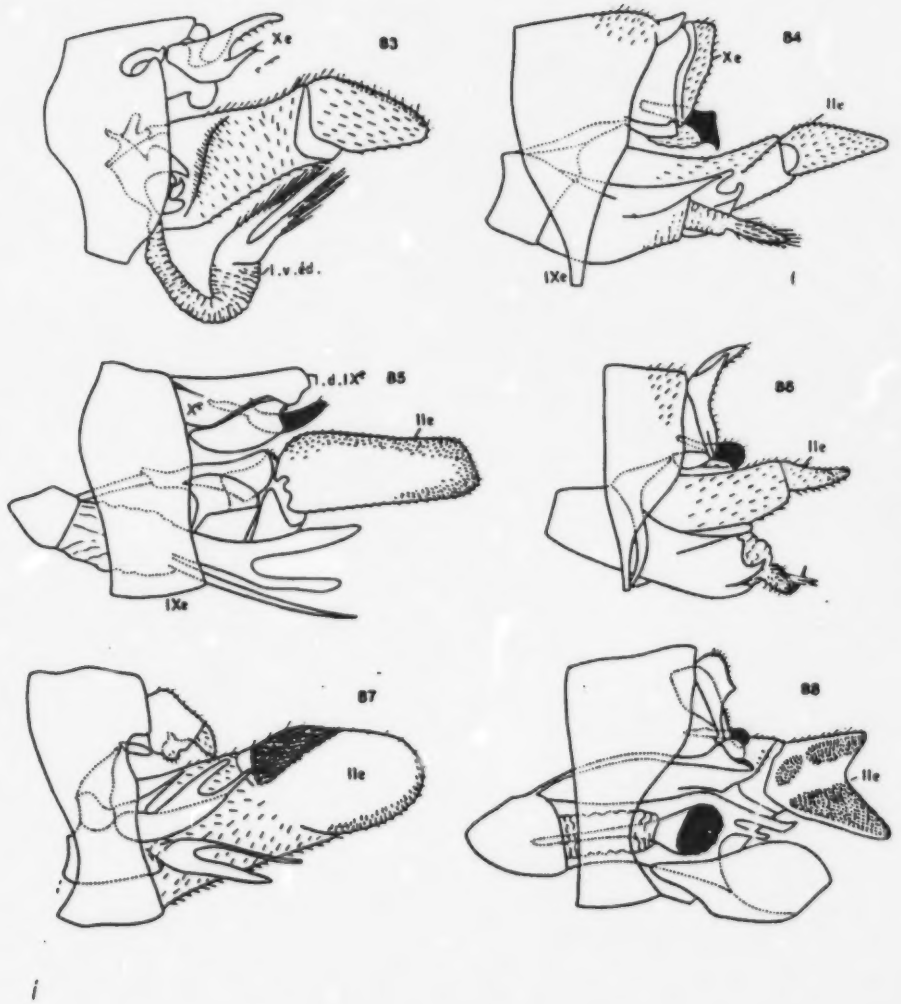
FIGS. 57-64. 57, Rh. kincaidi, male genitalia in profile. 58, Rh. tucula, male genitalia in profile. 59-60, Rh. milnei: 59, male genitalia in profile; 60, dorsal unit from above. 61-62, Rh. vagrita: 61, male genitalia in profile; 62, dorsal unit from above. 63, Rh. arnaudi, male genitalia in profile. 64, Rh. vedra, male genitalia in profile.



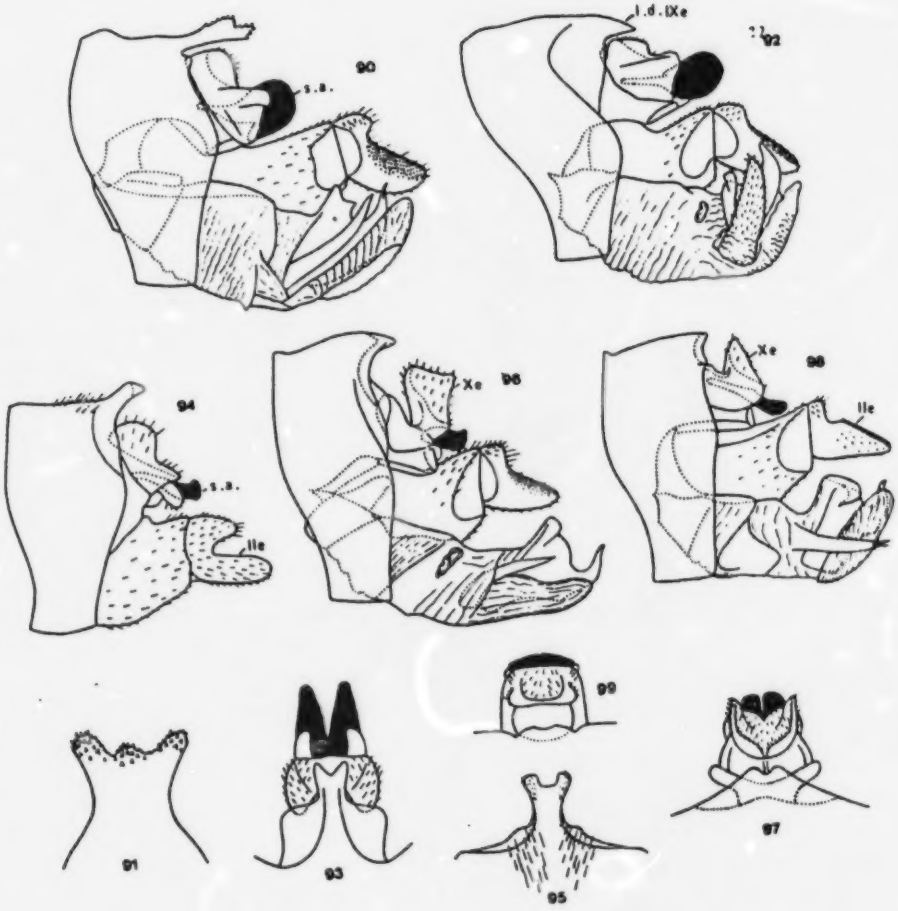
FIGS. 65-73. 65, Rh. unimaculata, male genitalia in profile. 66, Rh. visor, male genitalia in profile. 67-68, Rh. belona: 67, male genitalia in profile; 68, Xth segment from above. 69-70, Rh. vetina: 69, male genitalia in profile; 70, Xth segment from above. 71, Rh. perda, male genitalia in profile. 72-73, Rh. alexanderi: 72, male genitalia in profile; 73, tubercule of the IVth abdominal segment.



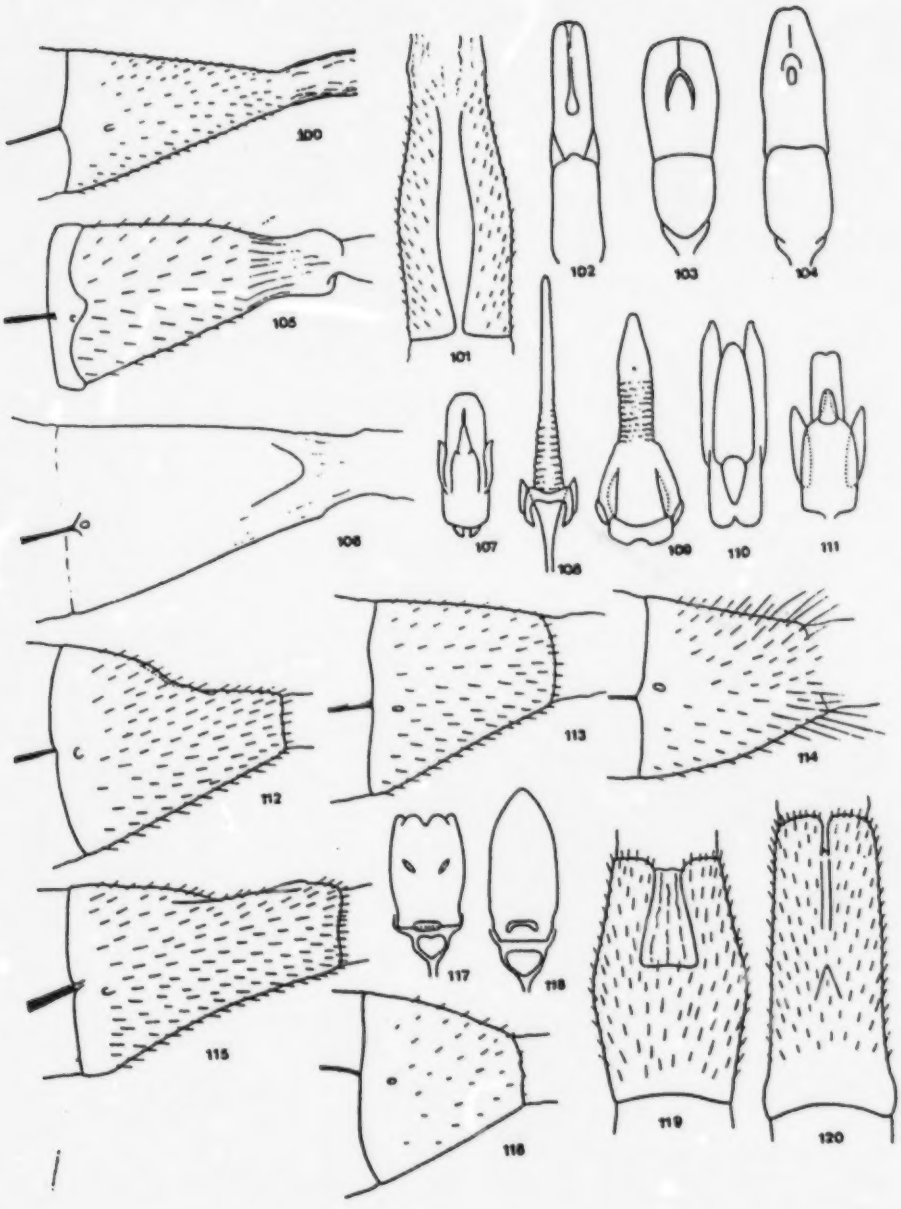
FIGS. 74-82. 74, Rh. vobara, male genitalia in profile. 75, Rh. ophrys, male genitalia in profile. 76, Rh. iranda, male genitalia in profile. 77, Rh. vofixa, male genitalia in profile. 78-79, Rh. manistee: 78, male genitalia in profile; 79, ventral lobe of the aedeagus from above. 80-81, Rh. minora: 80, male genitalia in profile; 81, ventral lobe of the aedeagus from above. 82, Rh. atrata, male genitalia in profile.



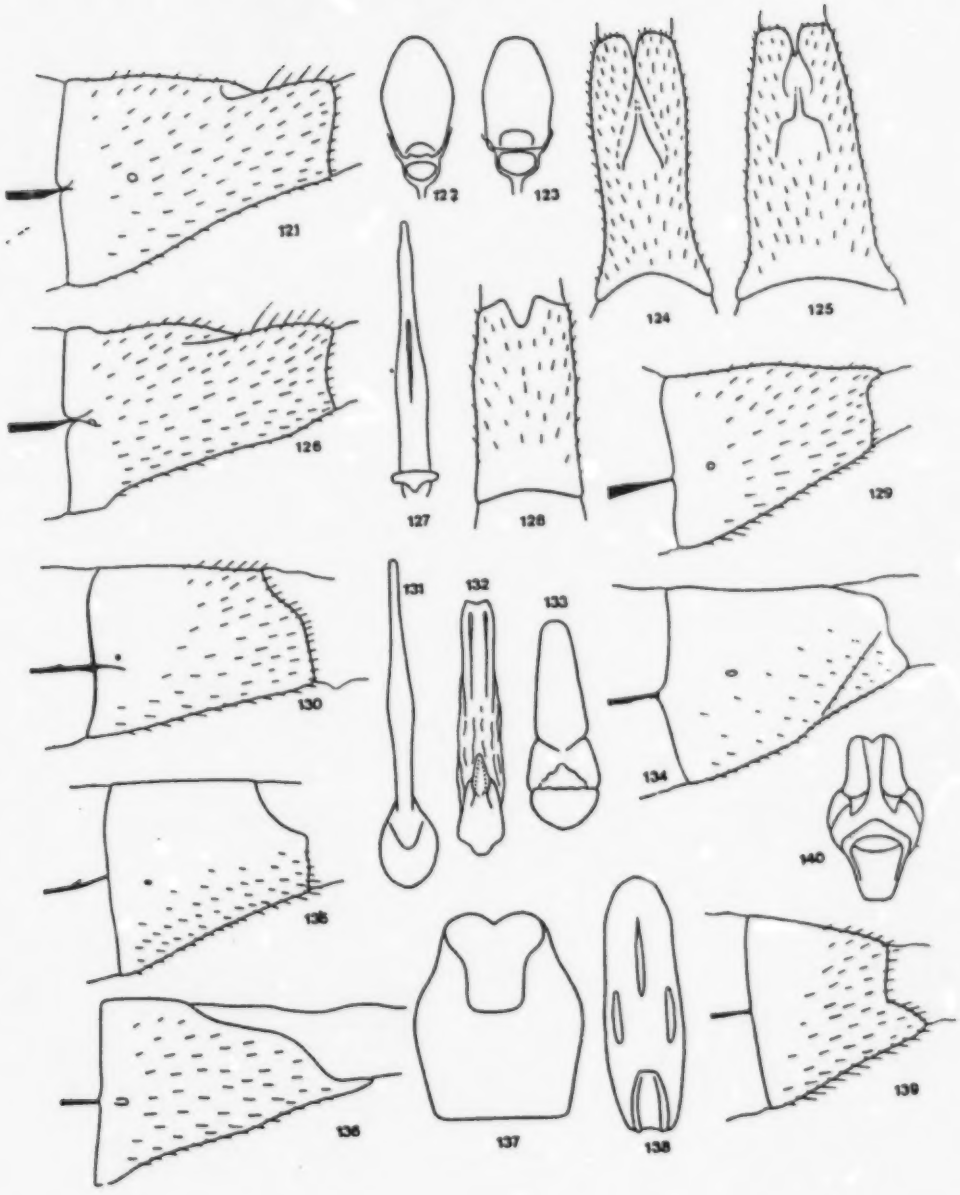
FIGS. 83-88. 83, Rh. glaberrima, male genitalia in profile. 84, Rh. fuscula, male genitalia in profile. 85, Rh. torva, male genitalia in profile. 86, Rh. vuphipes, male genitalia in profile. 87, Rh. melita, male genitalia in profile. 88, Rh. carolina, male genitalia in profile.



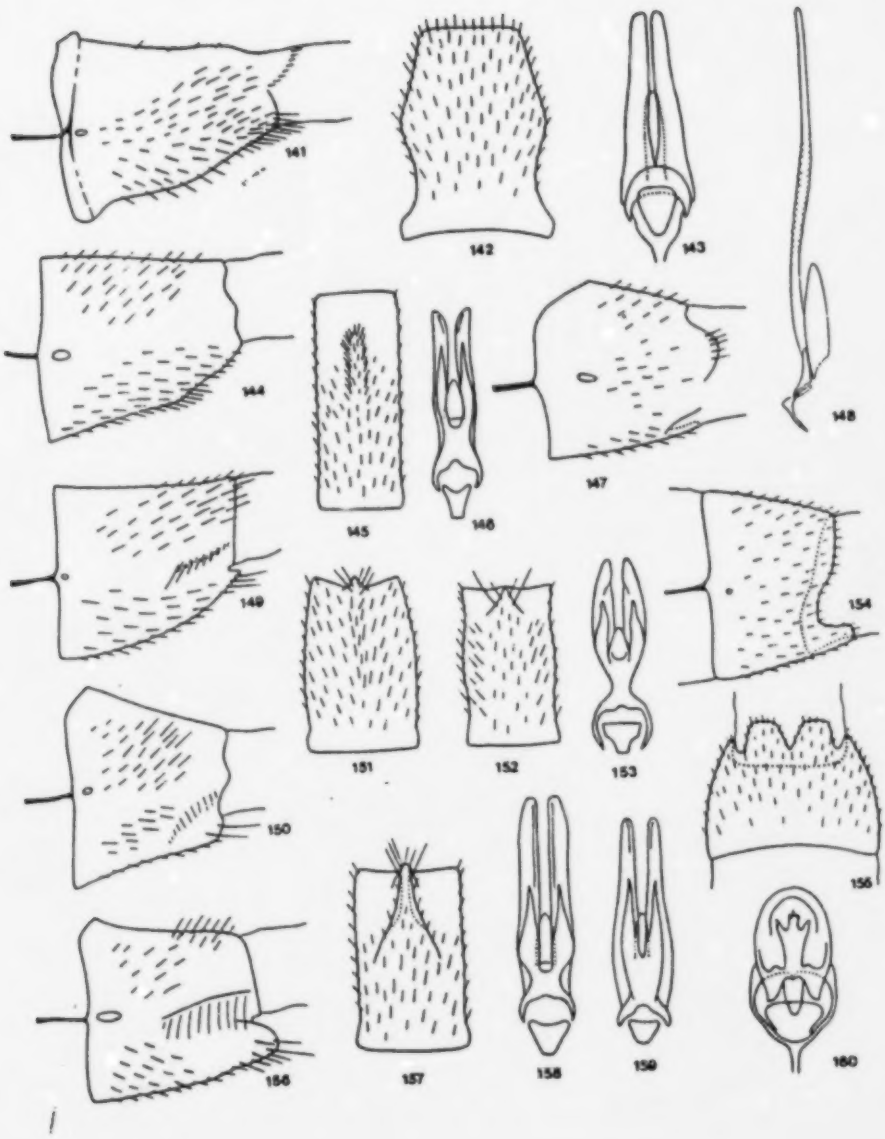
FIGS. 90-99. 90-91, Rh. invaria: 90, male genitalia in profile; 91, apicodorsal lobe of the IXth segment from above. 92-93, Rh. vibox: 92, male genitalia in profile; 93, apicodorsal lobe of the IXth and Xth segments from above. 94-95, Rh. banksi: 94, male genitalia in profile; 95, apicodorsal lobe of the IXth segment from above. 96-97, Rh. nigrita: 96, male genitalia in profile; 97, apicodorsal lobe of the IXth and Xth segments from above. 98-99, Rh. carpenteri: 98, male genitalia in profile; 99, apicodorsal lobe of the IXth and Xth segments from above.



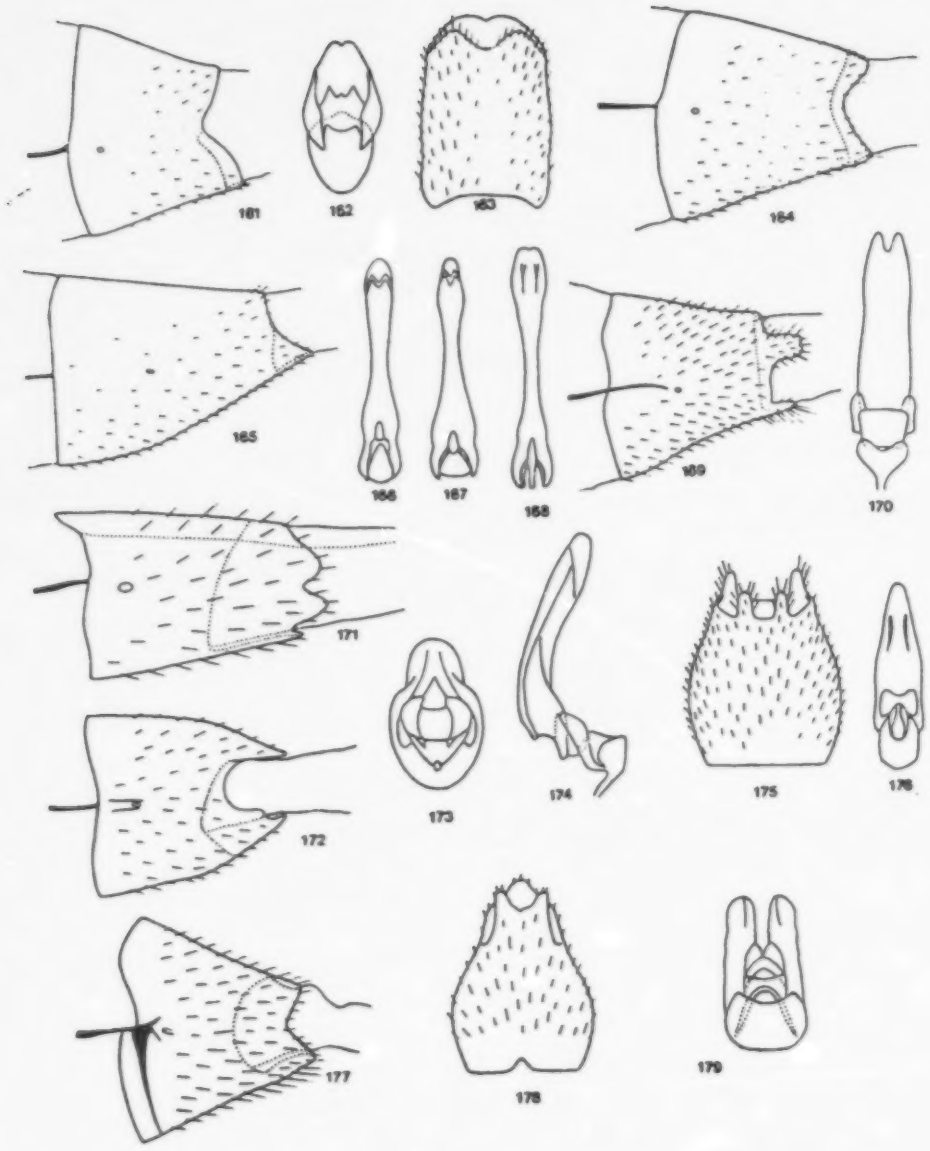
FIGS. 100-120. 100-102, Rh. angelita: 100, VIIIth segment of the female in profile; 101, Id. from above; 102, vaginal apparatus. 103, Rh. perplana, vaginal apparatus. 104, Rh. vuzana, vaginal apparatus. 105, Rh. minora, VIIIth segment of the female in profile. 106, Rh. verrula, VIIIth segment of the female in profile. 107, Rh. blarina, vaginal apparatus. 108, Rh. verrula, vaginal apparatus. 109, Rh. arnaudi, vaginal apparatus. 110, Rh. manistee, vaginal apparatus. 111, Rh. minora, vaginal apparatus. 112, Rh. ebria, VIIIth segment of the female in profile. 113, Rh. blarina, VIIIth segment of the female in profile. 114, Rh. glaberrima, VIIIth segment of the female in profile. 115, Rh. rotunda, VIIIth segment of the female in profile. 116, Rh. arnaudi, VIIIth segment of the female in profile. 117, Rh. ebria, vaginal apparatus. 118, Rh. rotunda, vaginal apparatus. 119, Rh. ebria, VIIIth segment of the female from above. 120, Rh. rotunda, VIIIth segment of the female from above.



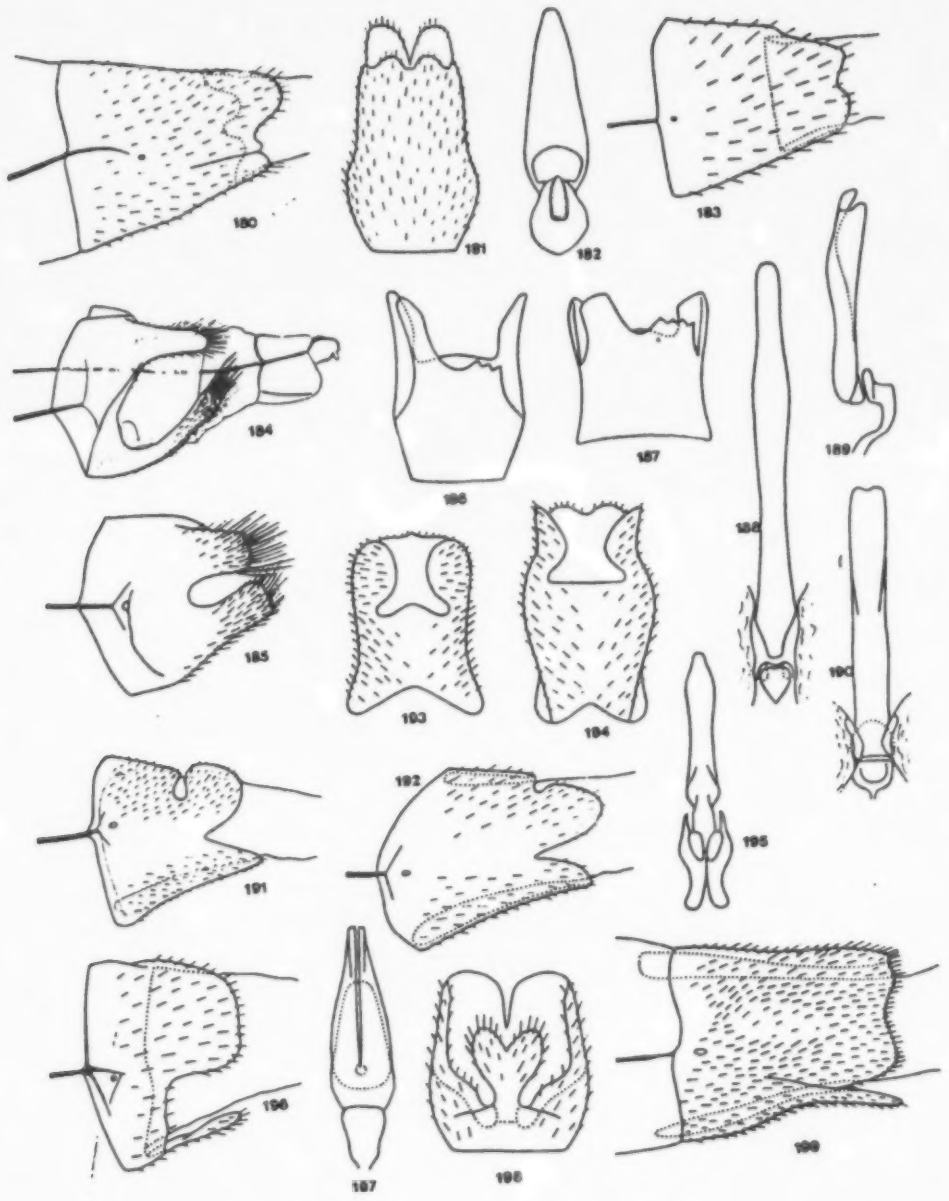
FIGS. 121-140. 121, Rh. norcuta, VIIIth segment of the female in profile. 122, Rh. tralala, vaginal apparatus. 123, Rh. norcuta, vaginal apparatus. 124, Rh. tralala, VIIIth segment of the female from above. 125, Rh. norcuta, VIIIth segment of the female from above. 126, Rh. tralala, VIIIth segment of the female in profile. 127-129, Rh. oreta: 127, vaginal apparatus; 128, VIIIth segment of the female from above; 129, Id, in profile. 130-131, Rh. vagrita: 130, VIIIth segment of the female in profile; 131, vaginal apparatus. 132, Rh. narvae, vaginal apparatus. 133, Rh. glaciera, vaginal apparatus. 134, Rh. carolina, VIIIth segment of the female in profile. 135, Rh. narvae, VIIIth segment of the female in profile. 136, Rh. torva, VIIIth segment of the female in profile. 137-138, Rh. carolina: 137, VIIIth segment of the female from above; 138, vaginal apparatus. 139, Rh. glaciera, VIIIth segment of the female in profile. 140, Rh. torva, vaginal apparatus.



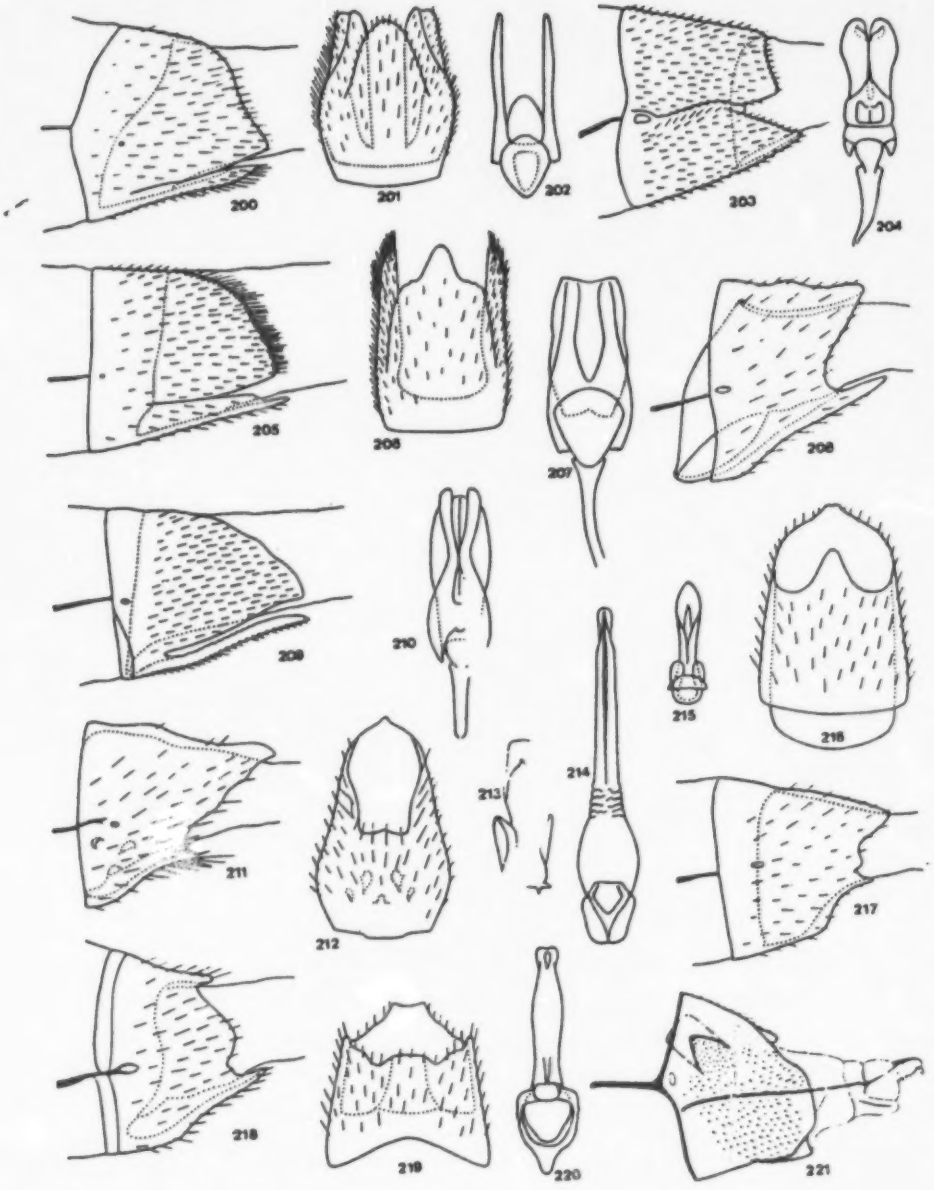
FIGS. 141-160. 141-143, Rh. vemna: 141, VIIIth segment of the female in profile; 142, Id, from below; 143, vaginal apparatus. 144-146, Rh. vao: 144, VIIIth segment of the female in profile; 145, Id, from below; 146, vaginal apparatus. 147-148, Rh. grandis: 147, VIIIth segment of the female in profile; 148, vaginal apparatus in profile. 149, Rh. inculta, VIIIth segment of the female in profile. 150, Rh. ignorata, VIIIth segment of the female in profile. 151, Rh. inculta, VIIIth segment of the female from below. 152, Rh. ignorata, VIIIth segment of the female from below. 153, Rh. inculta, vaginal apparatus. 154-155, Rh. vuphipes: 154, VIIIth segment of the female in profile; 155, Id from below. 156-158, Rh. acropedes: 156, VIIIth segment of the female in profile; 157, Id from below; 158, vaginal apparatus. 159, Rh. ignorata, vaginal apparatus. 160, Rh. vuphipes, vaginal apparatus.



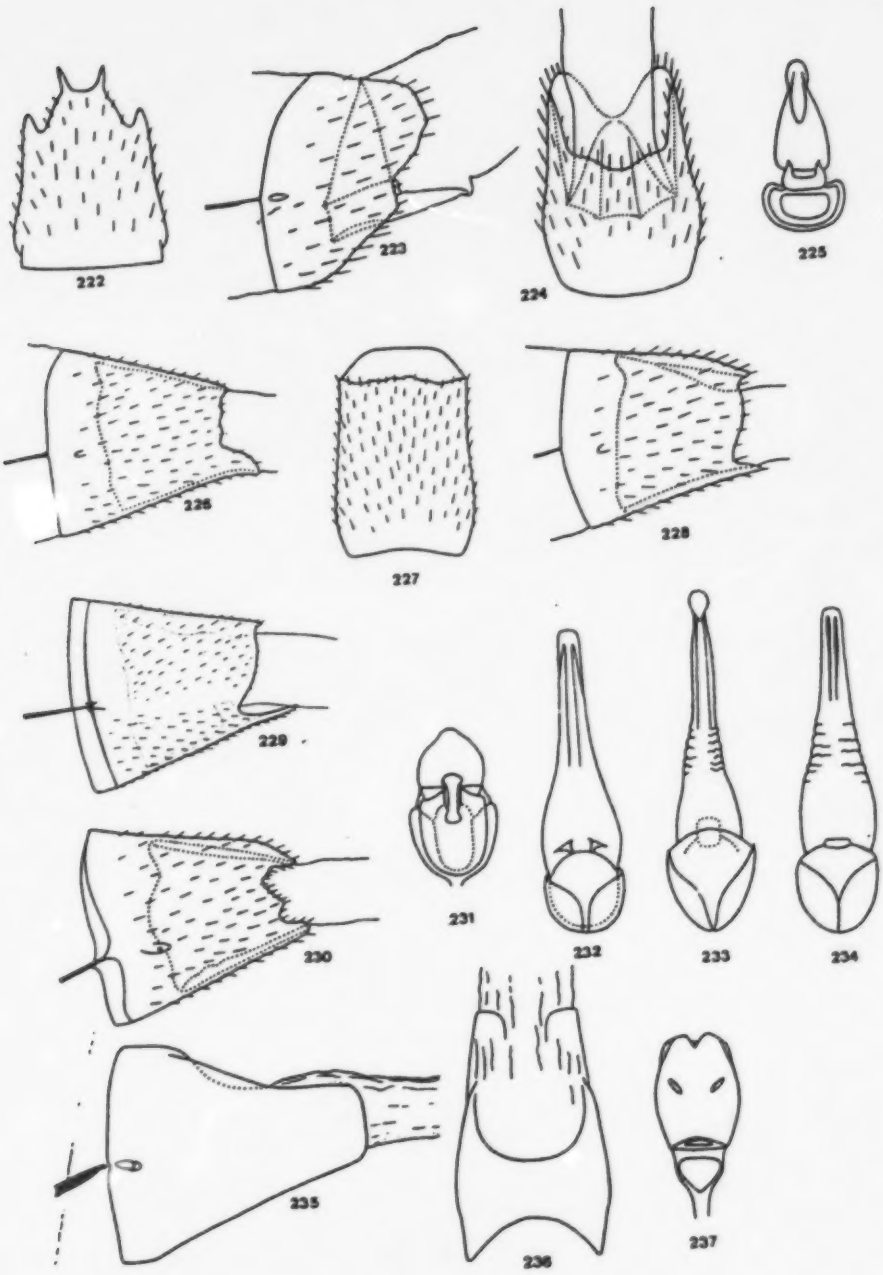
FIGS. 161-179. 161-162, Rh. melita: 161, VIIIth segment of the female in profile; 162, vaginal apparatus. 163-164, Rh. vobara: 163, VIIIth segment of the female from above; 164, Id in profile. 165, Rh. pellisa, VIIIth segment of the female in profile. 166, Rh. valuma, vaginal apparatus. 167, Rh. pellisa, vaginal apparatus. 168, Rh. atrata, vaginal apparatus. 169, Rh. vetina, VIIIth segment of the female in profile. 170, Rh. vobara, vaginal apparatus. 171, Rh. vofixa, VIIIth segment of the female in profile. 172-173, Rh. visor: 172, VIIIth segment of the female in profile; 173, vaginal apparatus. 174, Rh. vofixa, vaginal apparatus of the female in profile. 175-176, Rh. vetina: 175, VIIIth segment of the female from below; 176, vaginal apparatus. 177, Rh. vaefes, VIIIth segment of the female in profile. 178, Rh. visor, VIIIth segment of the female from above. 179, Rh. vaefes, vaginal apparatus.



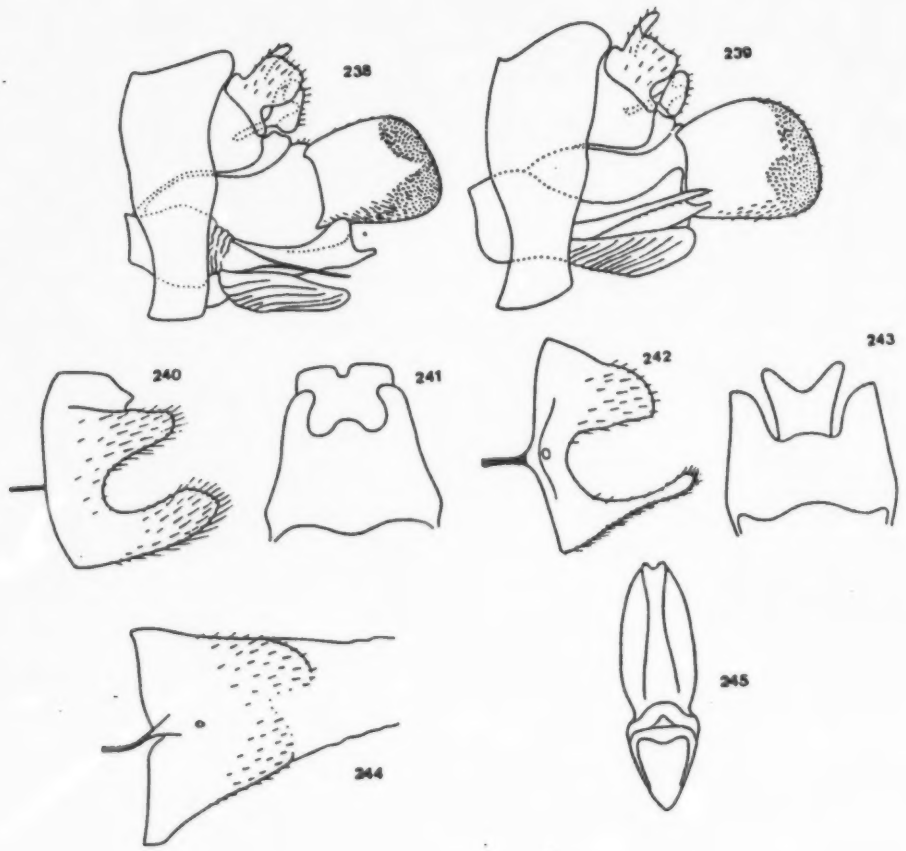
FIGS. 180-199. 180-182, Rh. belona: 180, VIIIth segment of the female in profile; 181, Id from below; 182, vaginal apparatus. 183, Rh. iranda, VIIIth segment of the female in profile. 184, Rh. bifila, VIII, Xth and XIth segments in profile. 185, Rh. jenniferae, VIIIth segment of the female in profile. 186, Rh. bifila, VIIIth segment of the female from below. 187, Rh. jenniferae, VIIIth segment of the female from below. 188, Rh. hyalinata, vaginal apparatus. 189, Rh. iranda, vaginal apparatus in profile. 190-191, Rh. vocala: 190, vaginal apparatus; 191, VIIIth segment of the female in profile. 192, Rh. hyalinata, VIIIth segment of the female in profile. 193, Rh. vocala, VIIIth segment of the female from above. 194, Rh. hyalinata, VIIIth segment of the female from above. 195, Rh. vedra, vaginal apparatus. 196-198, Rh. chilsia: 196, VIIIth segment of the female in profile; 197, vaginal apparatus; 198, VIIIth segment of the female from below. 199, Rh. vedra, VIIIth segment of the female in profile.



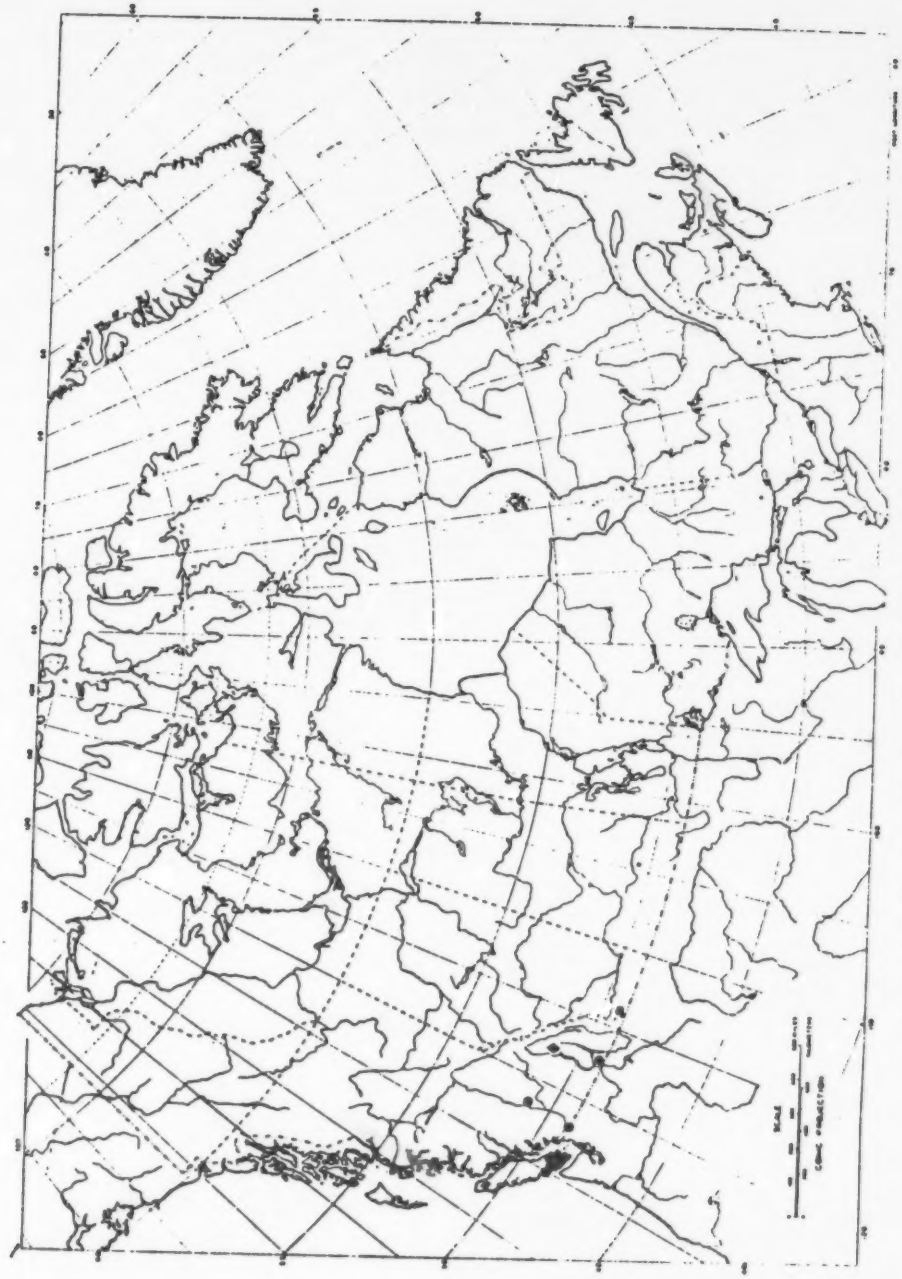
FIGS. 200-221. 200-202, Rh. fenderi: 200, VIIIth segment of the female in profile; 201, Id from below; 202, vaginal apparatus. 203-204, Rh. malkini: 203, VIIIth segment of the female in profile; 204, vaginal apparatus. 205-207, Rh. perda: 205, VIIIth segment of the female in profile; 206, Id from below; 207, vaginal apparatus. 208, Rh. carpenteri, VIIIth segment of the female in profile. 209-210, Rh. vaccua: 209, VIIIth segment of the female in profile; 210, vaginal apparatus. 211-213, Rh. nigrita: 211, VIIIth segment of the female in profile; 212, Id from below; 213, vaginal apparatus. 214, Rh. kincaidi, vaginal apparatus. 215-216, Rh. carpenteri: 215, vaginal apparatus; 216, VIIIth segment of the female from below. 217, Rh. kincaidi, VIIIth segment of the female in profile. 218-220, Rh. invaria: 218, VIIIth segment of the female in profile; 219, Id from above; 220, vaginal apparatus. 221, Rh. fuscula, VIIIth, Xth, and XIth segments in profile.



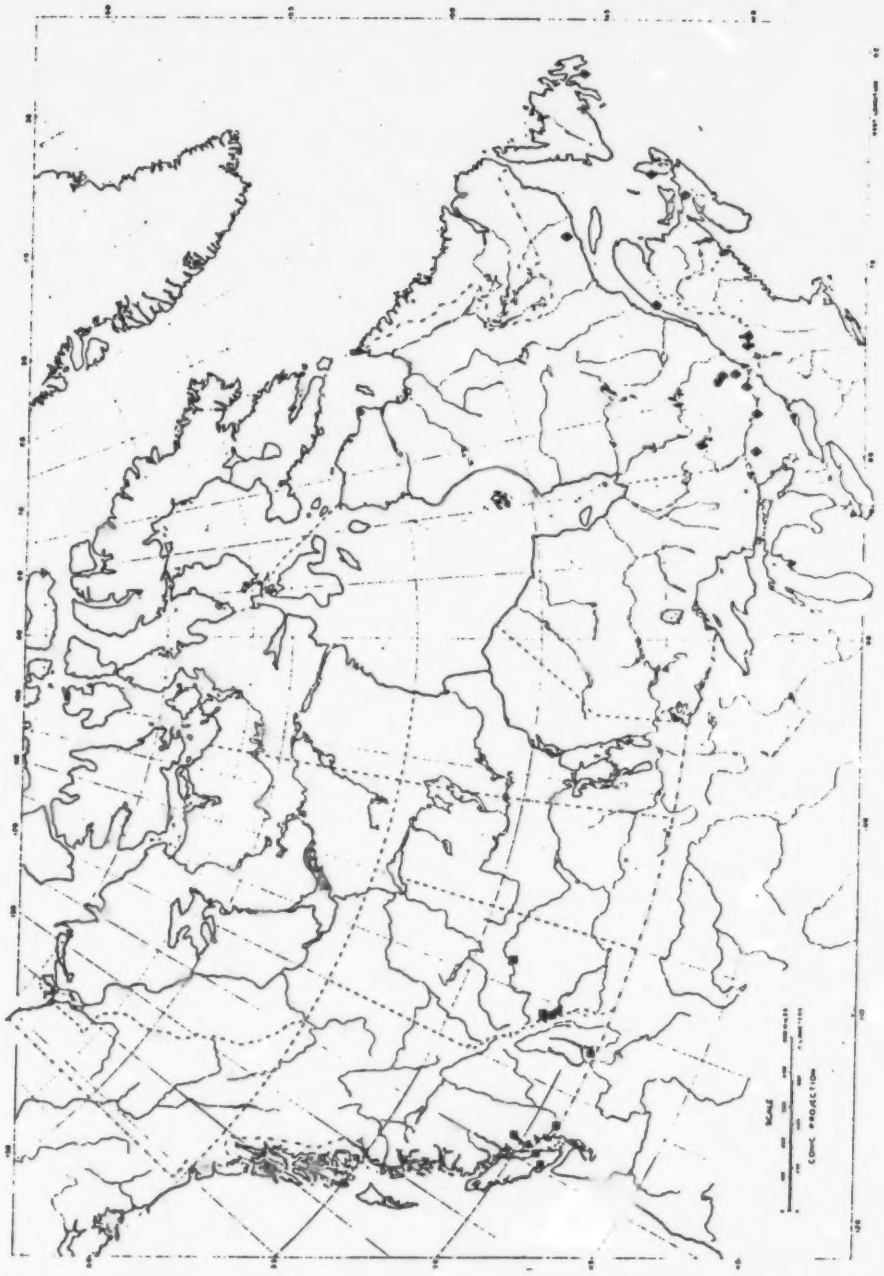
FIGS. 222-237. 222, Rh. banksi, VIIIth segment of the female from below. 223-225, Rh. vibox: 223, VIIIth segment of the female in profile; 224, Id from below; 225, vaginal apparatus. 226-227, Rh. tucula: 226, VIIIth segment of the female in profile; 227, Id from above. 228, Rh. alberta, VIIIth segment of the female in profile. 229, Rh. milnei, VIIIth segment of the female in profile. 230-231, Rh. unimaculata: 230, VIIIth segment of the female in profile; 231, vaginal apparatus. 232, Rh. milnei, vaginal apparatus. 233, Rh. tucula, vaginal apparatus. 234, Rh. alberta, vaginal apparatus. 235-237, Rh. donaldi: 235, VIIIth segment of the female in profile; 236, Id from above; 237, vaginal apparatus.



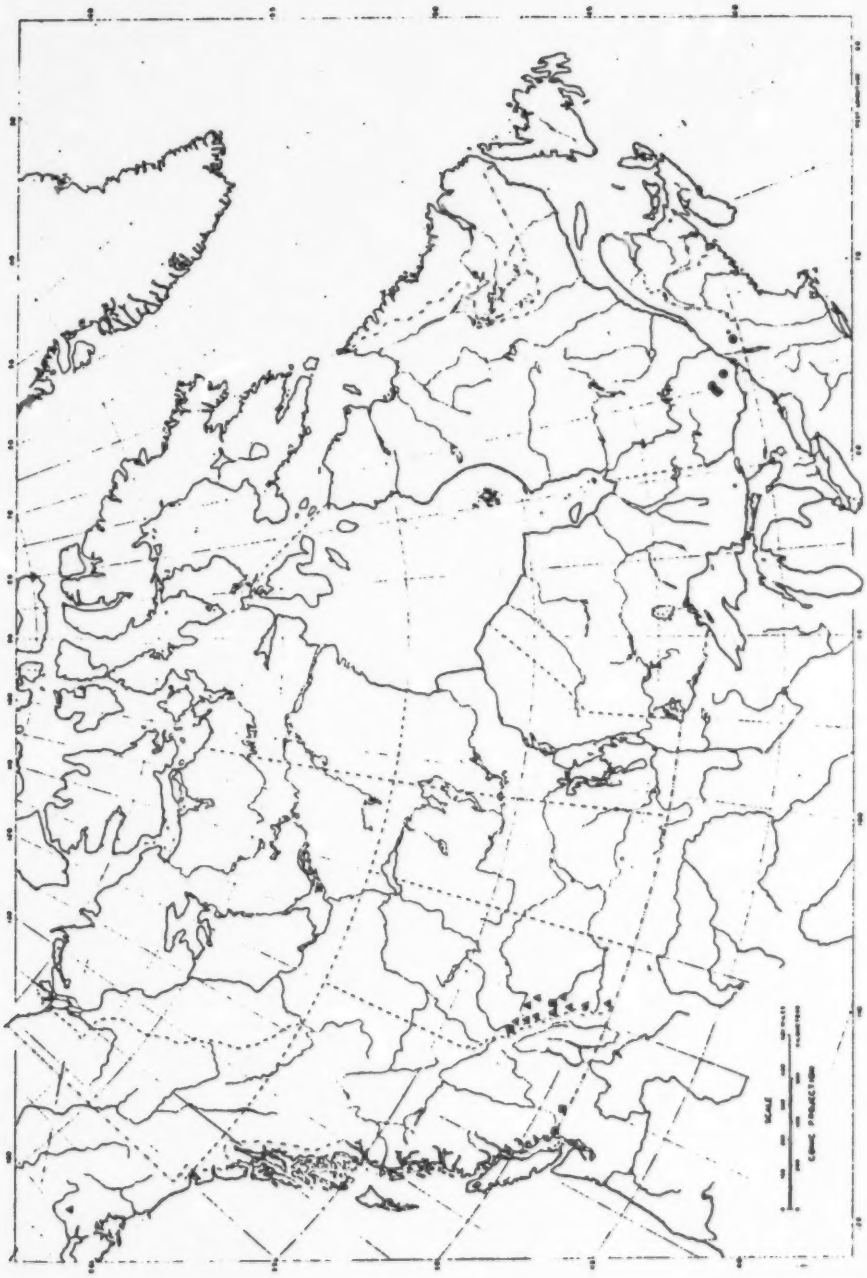
FIGS. 238-245. 238, Rh. jenniferae, male genitalia in profile. 239, Rh. coloradensis idahoensis, male genitalia in profile. 240-241, Rh. insularis: 240, VIIIth segment of the female in profile; 241, Id from above. 242-243, Rh. coloradensis idahoensis: 242, VIIIth segment of the female in profile; 243, Id from above. 244-245, Rh. rickeri: 244, VIIIth segment of the female in profile; 245, vaginal apparatus.



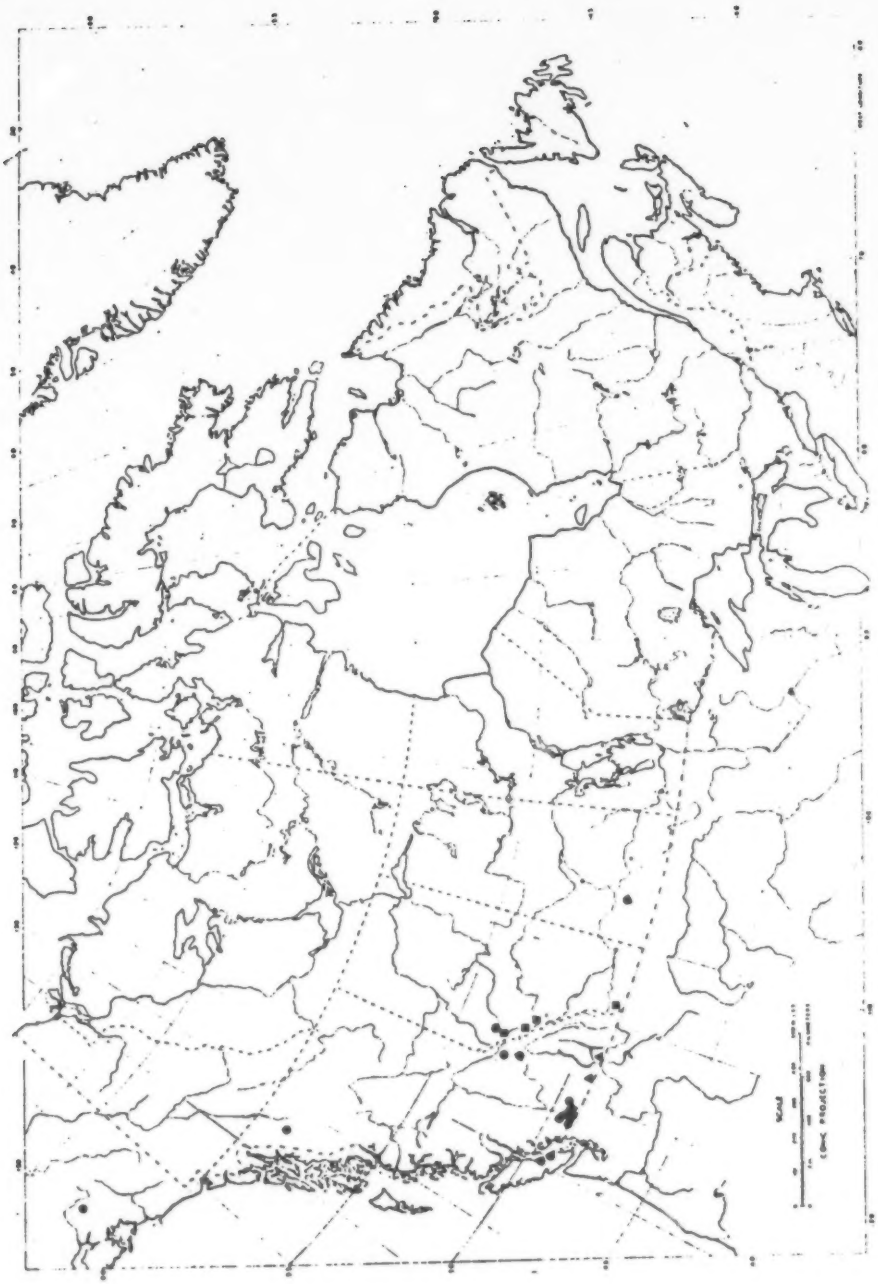
Map 1 showing the distribution of: ■ donaldi, ◆ ebria, ● norcuta.



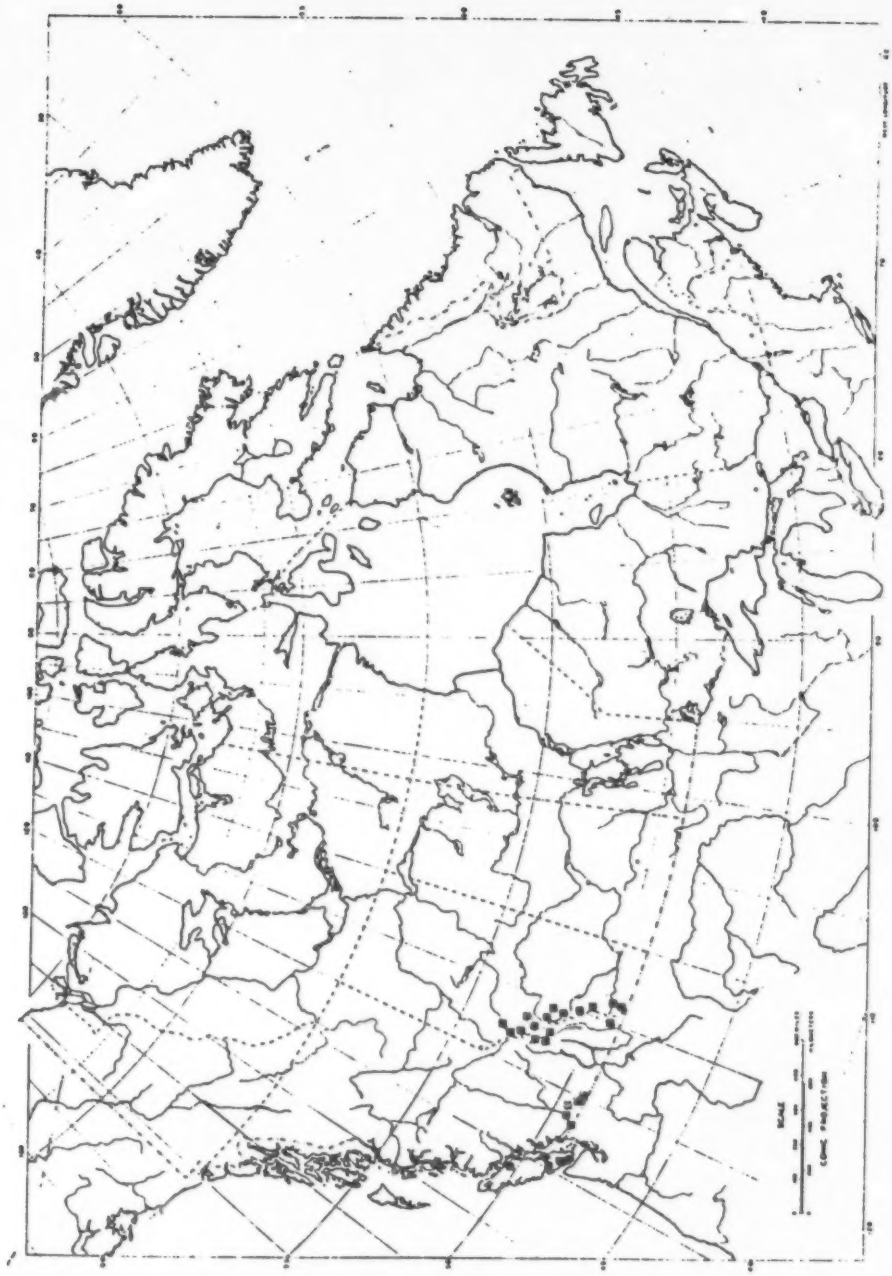
Map 2 showing the distribution of: ■ oreta, ◆ fuscula, ● vuphipes, ▲ milnei.



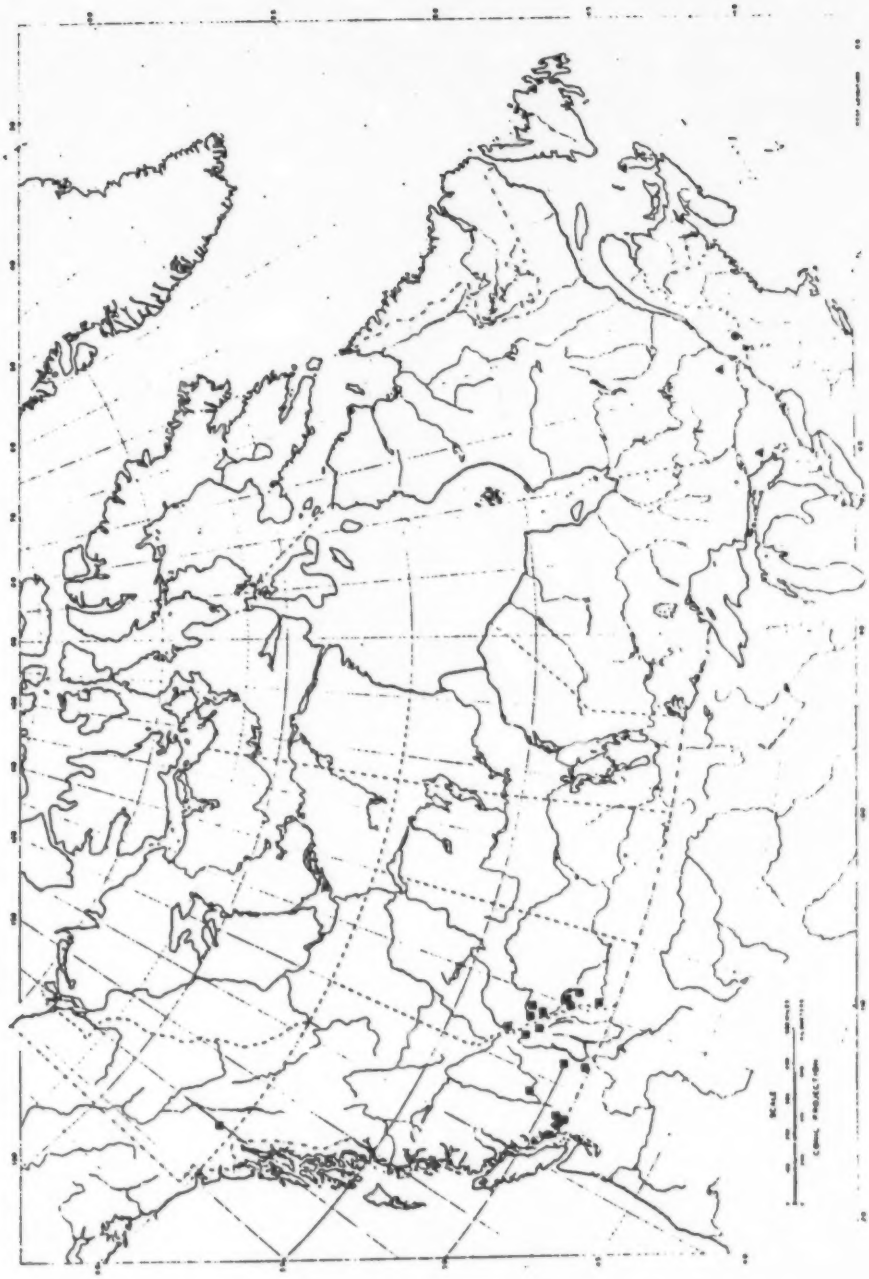
Map 3 showing the distribution of: ■ vagrita, ● glabemima, ● carolina, ▲ alberta.



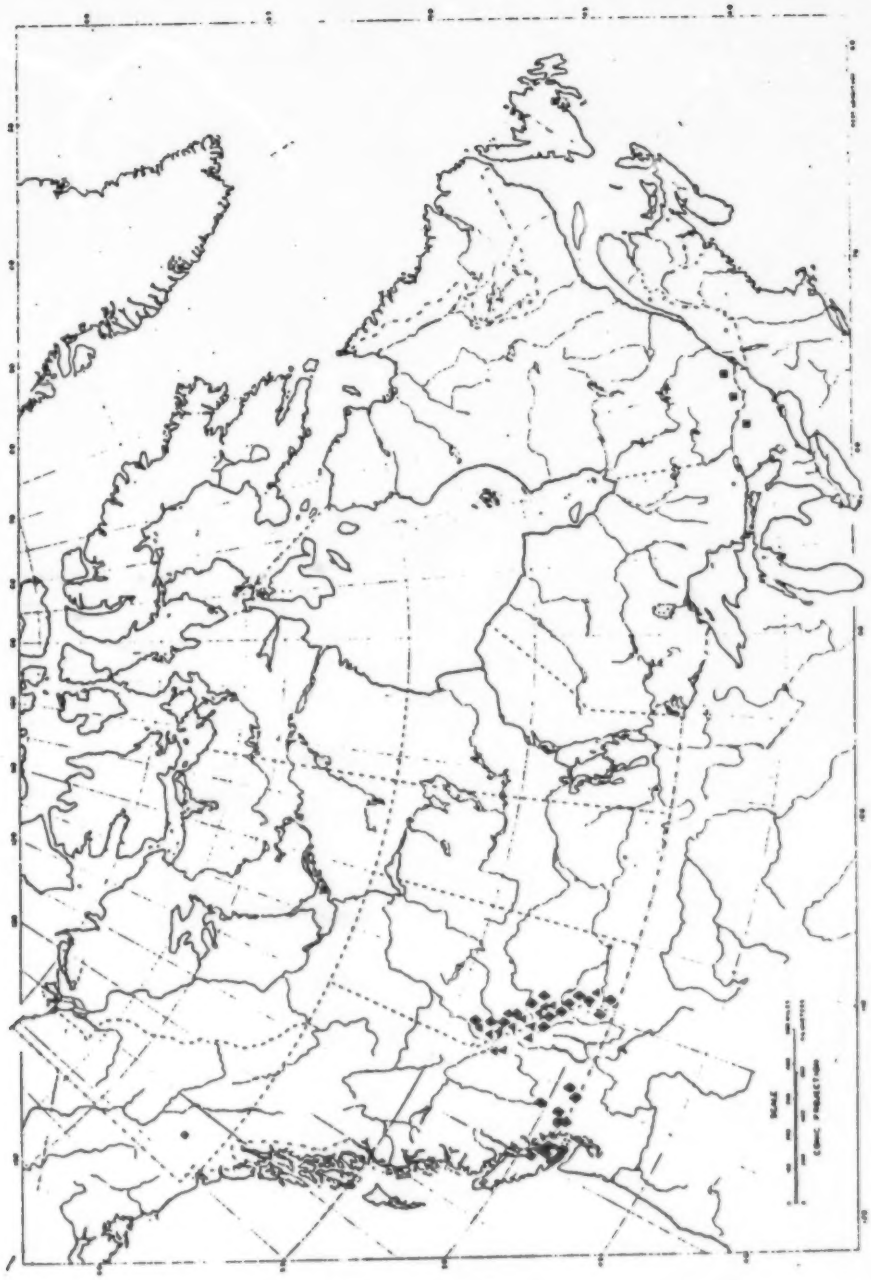
Map 4 showing the distribution of: ■ glaciera, ◆ kincaidi, ● tucula, ▲ hyalinata.



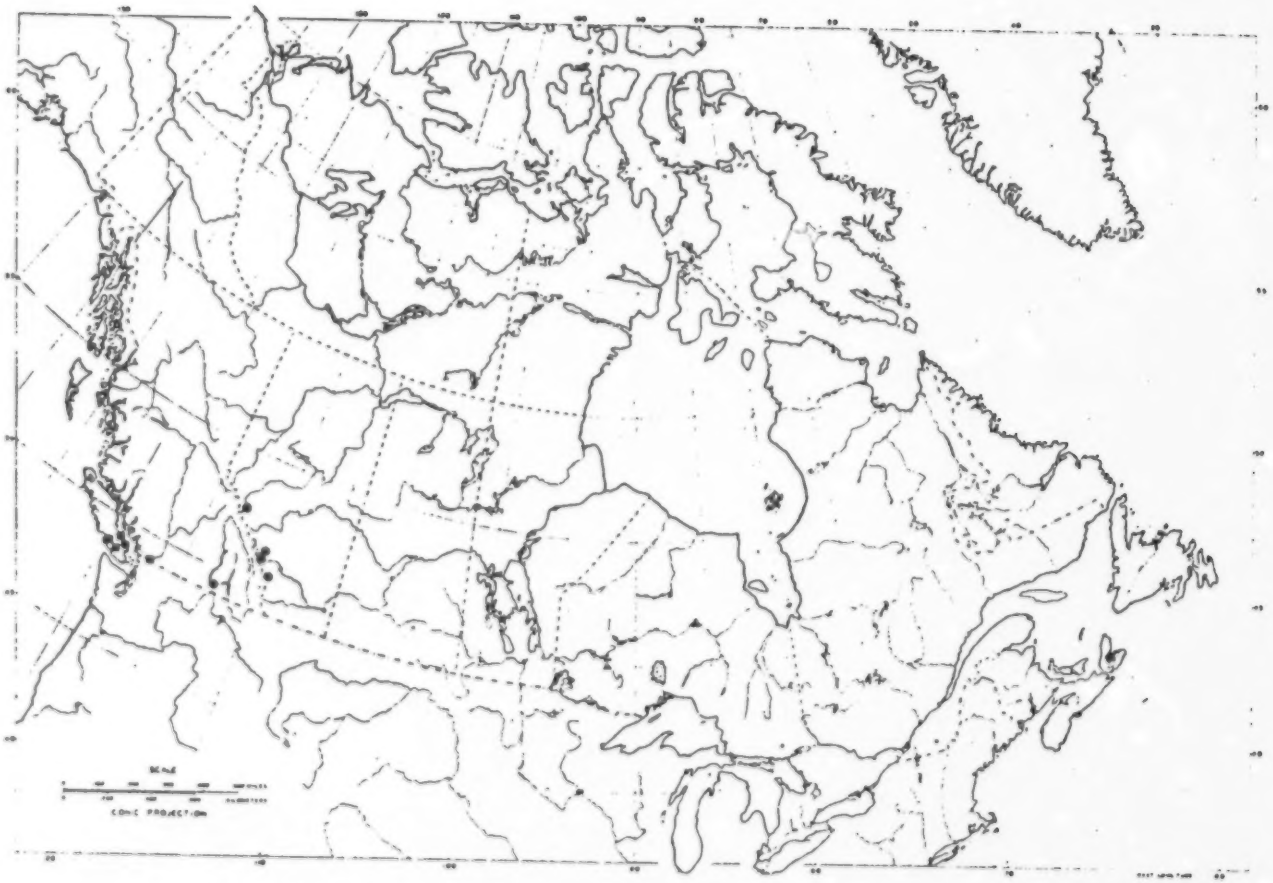
Map 5 showing the distribution of: ■ vocals. ◆ insulars.



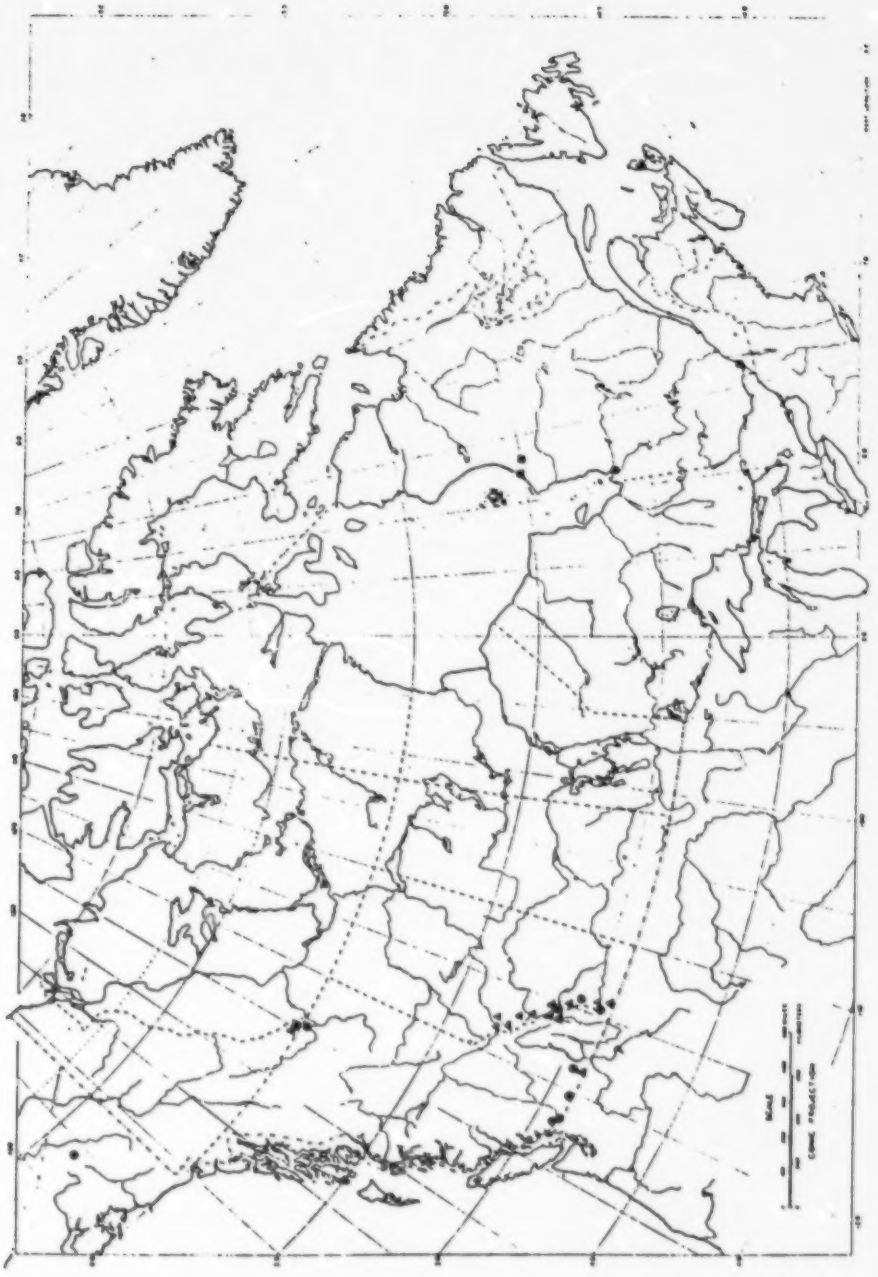
Map 6 showing the distribution of: ■ bifila, ● jenniferae, ● carpenteri, ▲ invaria.



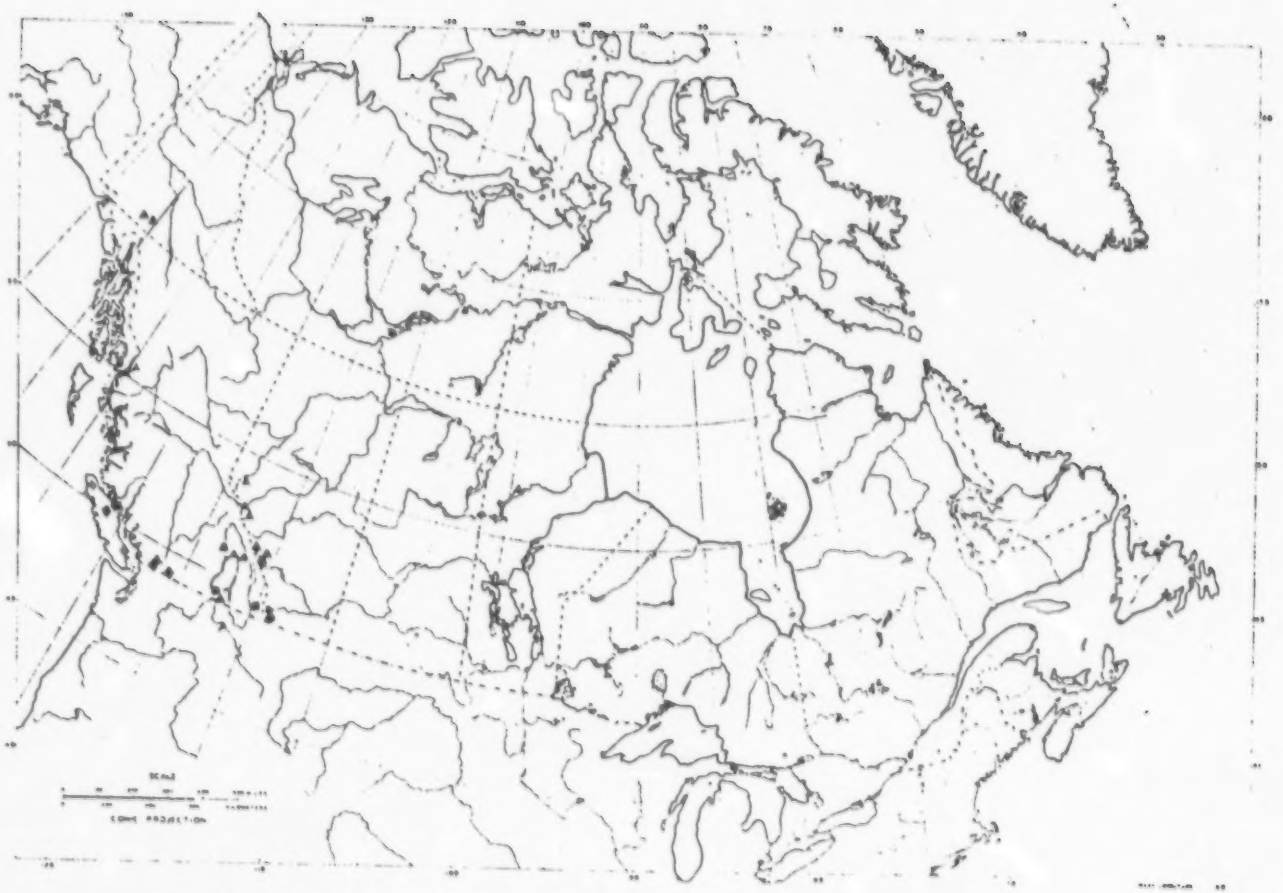
Map 7 showing the distribution of: ■ vibox, ◆ angelita, ● perplana, ▲ coloradensis idahoensis.



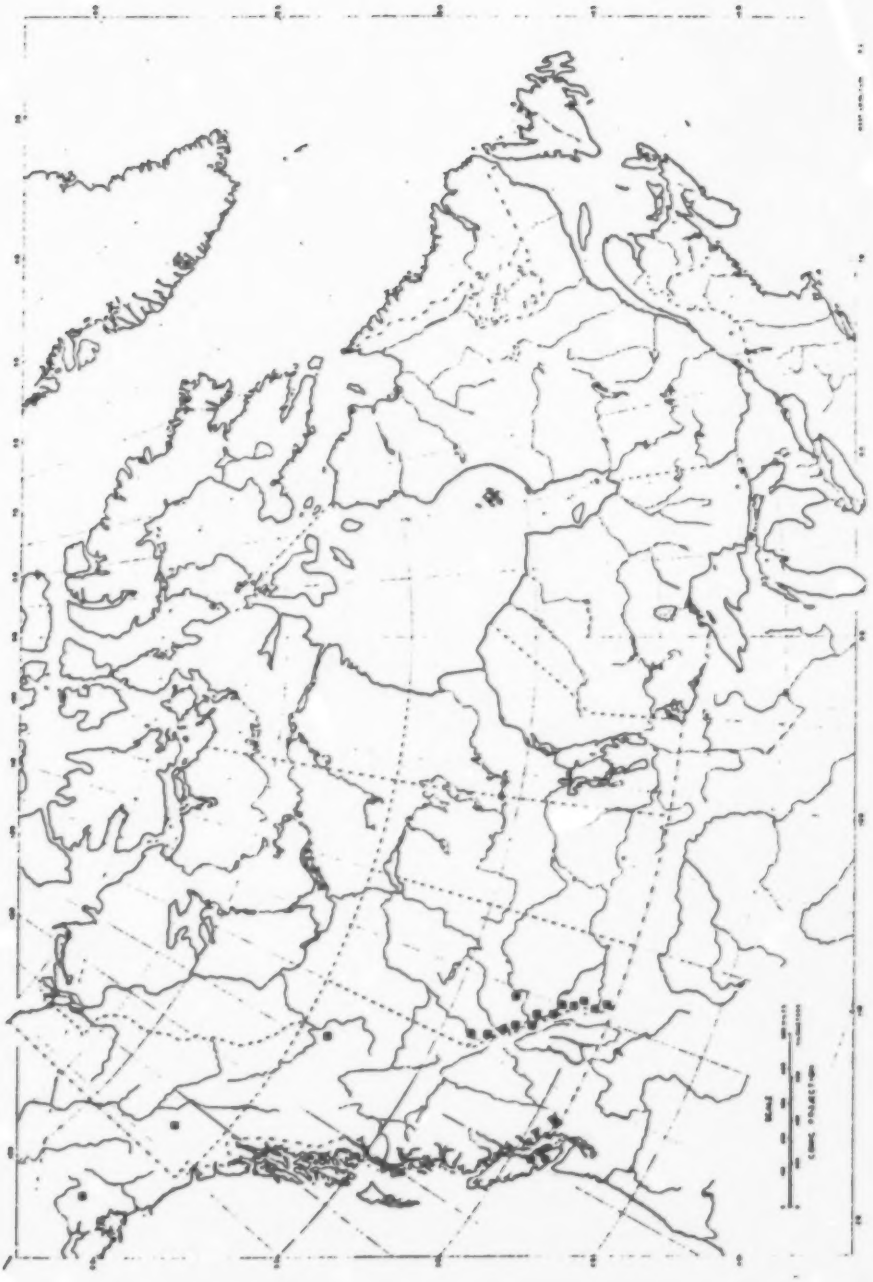
Map 8 showing the distribution of: ■ vuzana, ◆ atrata, ● belona, ▲ manistee.



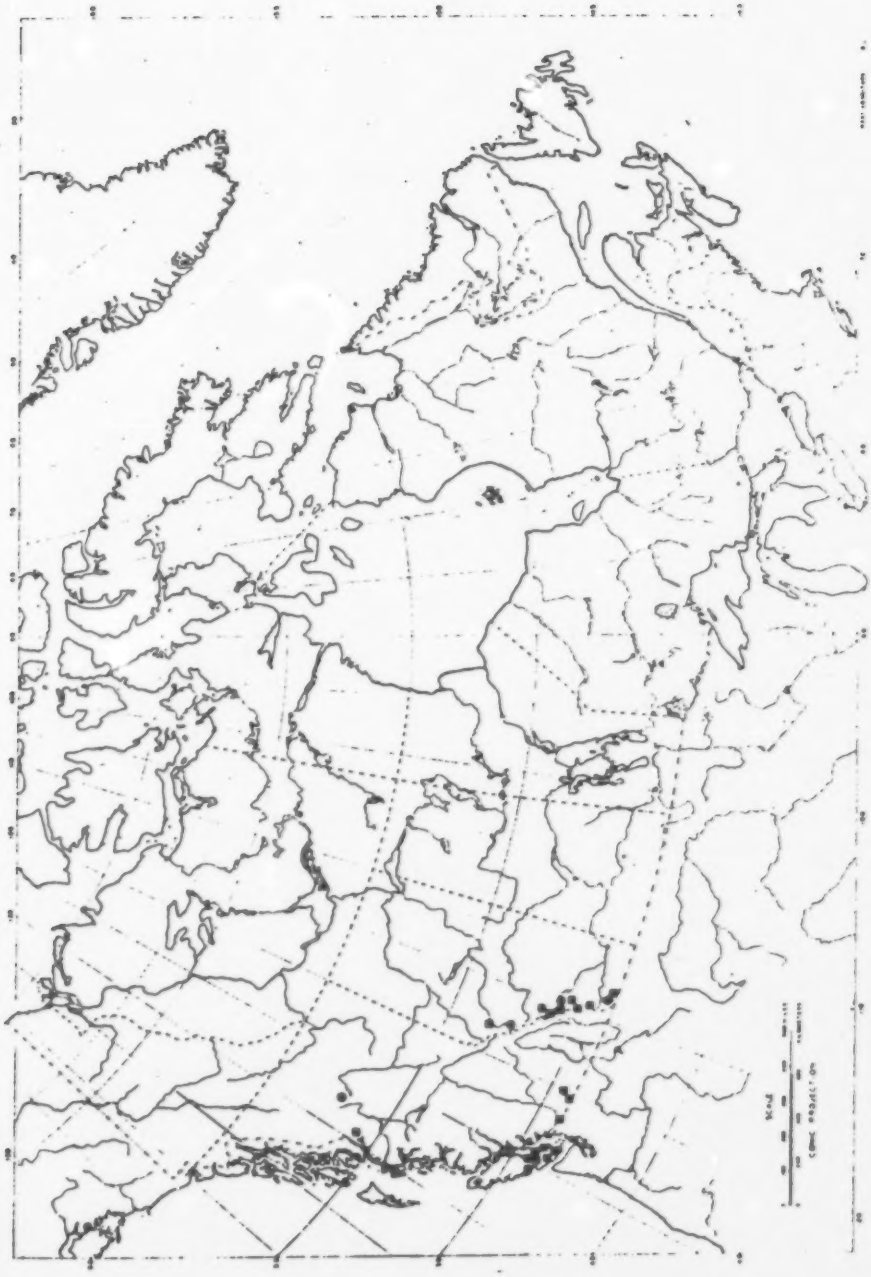
Map 9 showing the distribution of: ■ melita, ◆ minora, ● narvae, ▲ pellita.



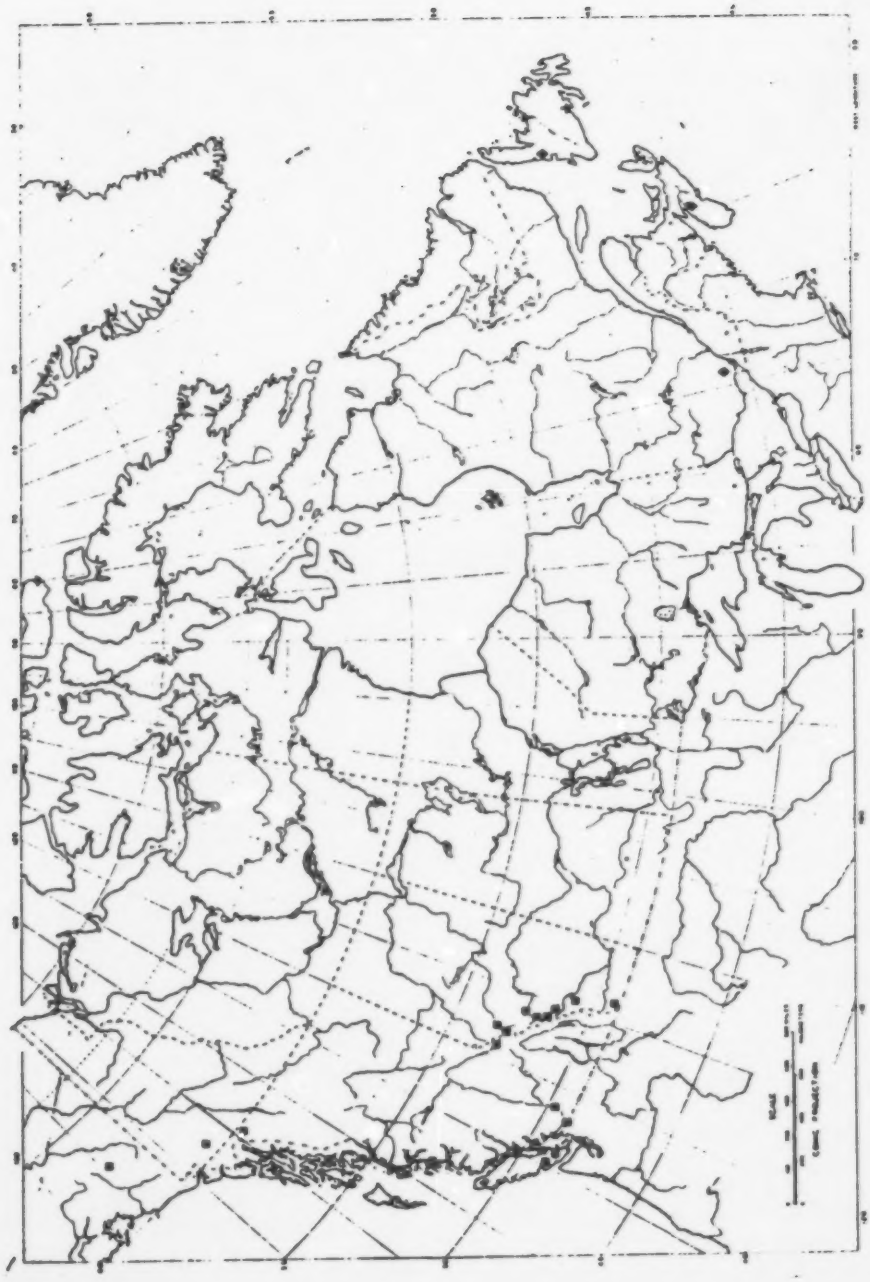
Map 10 showing the distribution of: ■ unimaculata, ◆ valuma, ● ophrys, ▲ vohara.



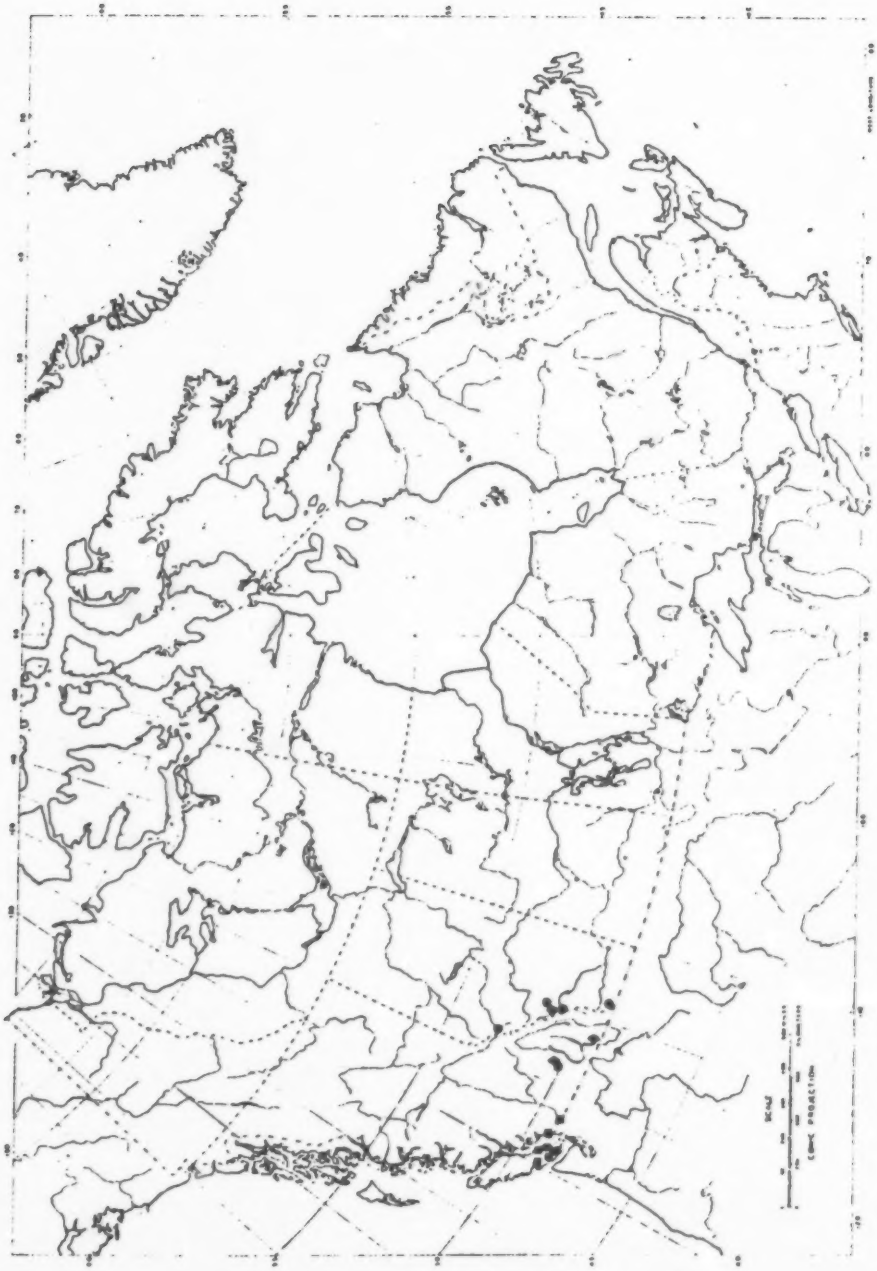
Map 11 showing the distribution of: ■ vofua, ◆ chilsia, ● malkini, ▲ perda.



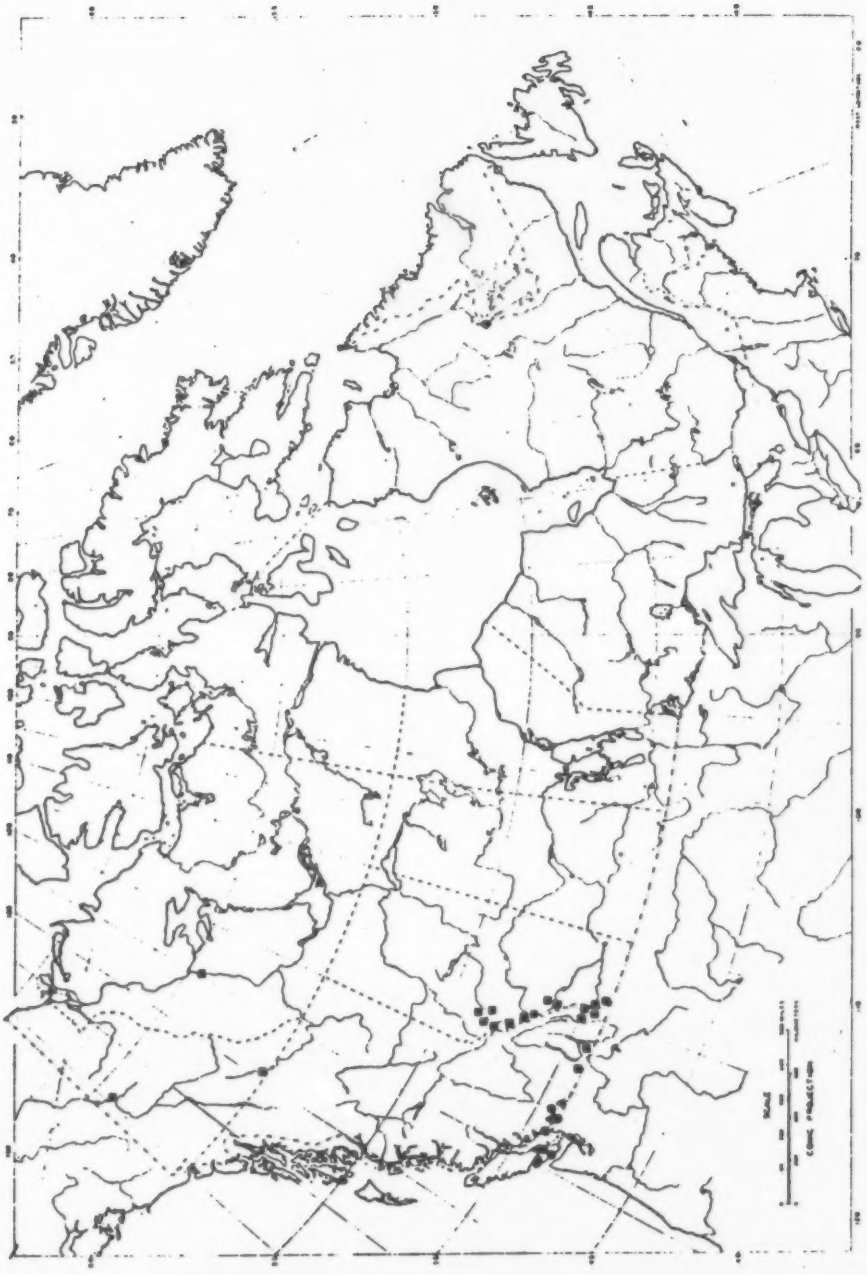
Map 12 showing the distribution of: ■ vaccua, ◆ autumnalis, ● rickeii.



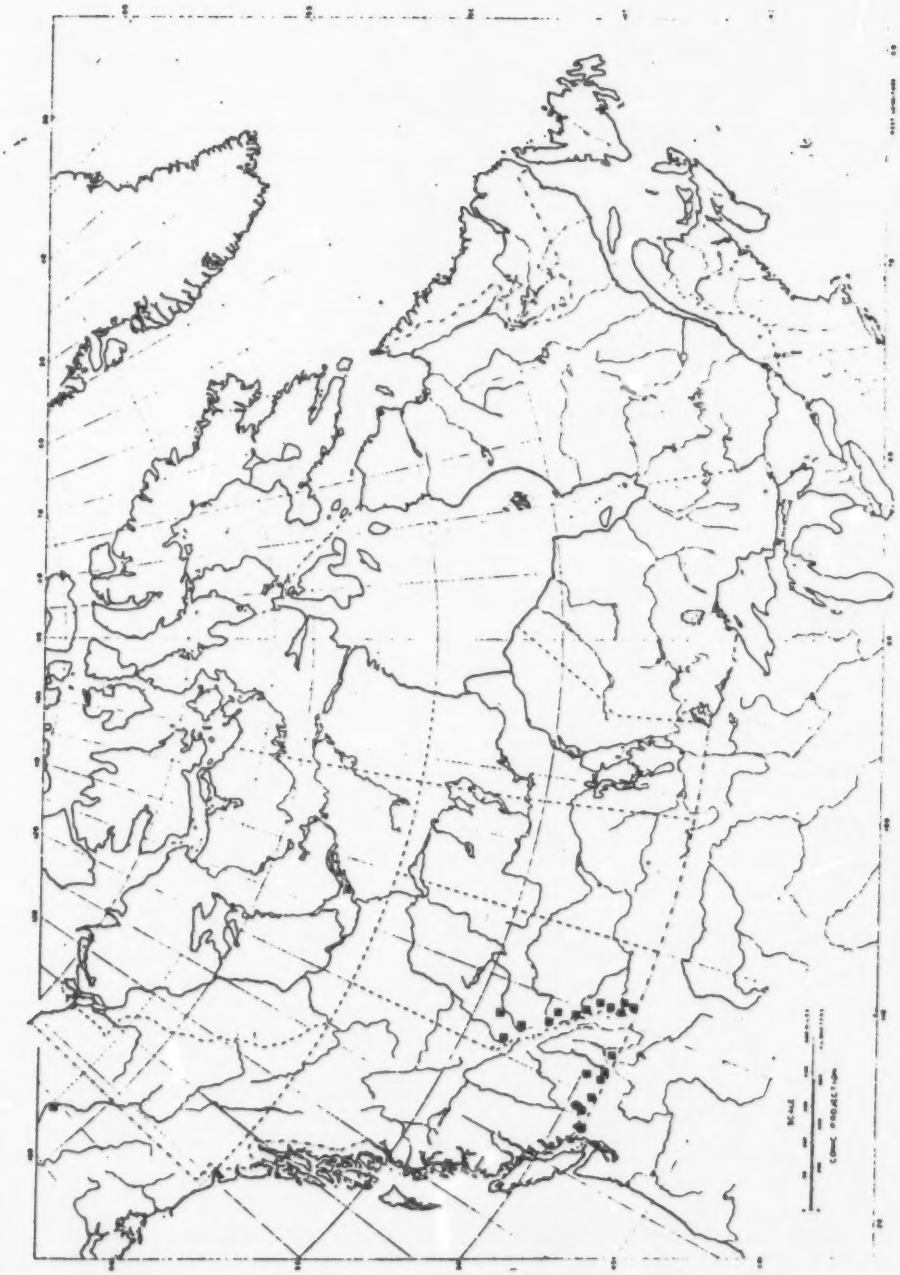
Map 13 showing the distribution of: ■ vernula, ● larva.



Map 14 showing the distribution of: ■ grandis, ◆ robusta, • vemna.



Map 15 showing the distribution of: ■ acropedes, ◆ ignorata, ● inculta, ▲ vaefes.



Map 16 showing the distribution of: ■ vao, ◆ arnaudi, ● vison.